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State of Connecticut

PUBLIC DOCUMENT No. 24

Fifty-Second Report

OF THE

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

NEW HAVEN

FOR THE YEAR
1928

State of Connecticut

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1928

PRINTED IN COMPLIANCE WITH STATUTE

NEW HAVEN

PUBLISHED BY THE STATE

1929

Publication
Approved By
The Board of Control

Press of The Wilson H. Lee Co., New Haven, Conn.

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CONNECTICUT AGRICULTURAL EXPERIMENT STATION

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As of

October 31, 1928

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Herbert A. Lunt, M.S., *Assistant in Forest Soils.*
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Letter of Transmittal

To His Excellency, John H. Trumbull, Governor of Connecticut:

The Board of Control of the Connecticut Agricultural Experiment Station, as required by law, herewith submits its fifty-second annual report for the year ending October 31st, 1928.

No extended statement is presented in this letter. The Report of the Director (Bulletin 298, pages 113 to 140), which constitutes a part of this report, is a summary of the work accomplished during the year, lists the changes in staff, the additions to equipment and the publications.

Immediately following this letter will be found the financial statements of the several appropriations for which the station is responsible. These are for the fiscal year ending June 30th, 1928.

All of which is respectfully submitted,

GEORGE A. HOPSON,

Secretary of the Board.

Report of the Treasurer

July 1, 1927—June 30, 1928

W. L. Slate, in account with The Connecticut Agricultural Experiment Station for the fiscal year ended June 30, 1928.

Receipts.

Balance on hand, July 1, 1927		
State Comptroller (General or Current Expense)	$53,000.00	
" " (General—Additions)	827.75	
" " (Food and Drug)	7,500.00	
United States Appropriation (Hatch)	7,500.00	
" " " (Adams)	7,500.00	
" " " (Purnell)	20,000.00	
" " " (Clark-McNary)	959.48	
Fertilizer Analysis Fees	13,000.00	
Feed Analysis Fees	7,000.00	
Lockwood Trust Fund	11,000.00	
		$128,287.23
Miscellaneous Receipts:		
Balance on hand, July 1, 1927	$201.46	
Sales of gasoline	$452.16	
Sales of automobile oil	36.85	
Mileage for use of automobiles	218.17	
Sale of waste paper	3.57	
Refund for damage to Station auto	31.85	
Interest on bank deposits	83.52	
	826.12	
	1,027.58	
Less Miscellaneous Receipts Deposited with State Treasurer	908.35	
		119.23
		$128,406.46

Disbursements.

Salaries	$76,441.66
Labor	19,986.22
Stationery and Office Supplies	784.79
Scientific Supplies (chemicals)	1,074.25
" " (other laboratory supplies)	835.55
" " (photographic supplies)	192.71
Feeding Stuffs	77.22
Insecticides, etc.	74.97
Lumber and Small Hardware	41.76
Miscellaneous Supplies	747.60

Automobile Oil	135.34	
Food and Drug Samples	4.38	
Fertilizers	774.65	
Telegraph and Telephone	549.26	
Postage	457.79	
Travel Expense (outlying-investigations)	2,886.85	
" " (meetings, conferences, etc.)	1,336.34	
" " (gasoline for automobiles)	1,041.06	
Freight, Express and Parcels Post	129.93	
Publications (bulletins, etc.)	126.70	
" (miscellaneous)	170.50	
Coal	2,330.00	
Gas and Electricity	1,849.34	
Water	204.55	
Furniture and Fixtures (new)	1,129.41	
" " (repairs)	111.39	
Library (books and periodicals)	1,063.61	
" (binding)	381.70	
Scientific Equipment (new)	2,093.28	
" " (repairs)	140.45	
Live Stock	110.00	
Automobiles (new)	1,653.75	
" (repairs)	533.71	
Tools, Machinery and Appliances (new)	1,205.91	
" " " (repairs)	300.09	
New Buildings and Structures	2,951.78	
Buildings (repairs and alterations)	3,142.13	
Grounds	6.80	
Insurance (fire, burglary and automobile)	1,079.48	
Miscellaneous Contingent Expenses	57.50	
Total Disbursements		$128,214.41
Balance on hand, June 30, 1928:		
State General Appropriation (in hands of State Comptroller)	72.82	
Miscellaneous Receipts (in hands of Station Treasurer)	119.23	
		192.05
		$128,406.46

REPORT OF

W. L. SLATE, Treasurer

IN ACCOUNT WITH

Insect Pest Appropriation

(Section 2109 of General Statutes, Revision of 1918)

July 1, 1927—June 30, 1928

RECEIPTS.

Balance on hand, July 1, 1927			.....
Insect Pest Appropriation		$30,000.00	
" " " (additions)		27.36	
			$30,027.36
Miscellaneous Receipts:			
Mileage for use of Automobiles...	$27.36		
LESS MISCELLANEOUS RECEIPTS DEPOSITED WITH STATE TREASURER...	27.36		.....
			$30,027.36

DISBURSEMENTS.

Salaries	$15,450.00	
Labor	16,709.25	
Stationery and Office Supplies	125.35	
Scientific Supplies (chemicals)	42.93	
" " (other laboratory supplies)	25.61	
" " (photographic supplies)	57.38	
Insecticides, etc	130.67	
Lumber and Small Hardware	.73	
Miscellaneous Supplies	841.64	
Automobile Oil	62.31	
Telegraph and Telephone	167.74	
Postage	91.22	
Travel Expense (outlying investigations)	2,219.31	
" " (meetings, conferences, etc.)	259.53	
" " (gasoline for automobiles)	507.06	
Freight, Express and Parcels Post	15.33	
Electricity	45.30	
Furniture and Fixtures (new)	180.65	
" " (repairs)	19.15	
Library (books and periodicals)	201.05	
" (binding)	82.35	
Scientific Equipment (new)	21.48	
Livestock	1.35	
Automobiles (new)	544.00	
" (repairs)	256.90	
Tools, Machinery and Appliances (new)	48.63	
" " " (repairs)	7.10	
New Buildings and Structures	234.24	
Buildings (repairs and alterations)	10.58	
Rent of Land and Buildings	314.66	
Insurance (automobile)	169.47	
Miscellaneous Contingent Expenses	72.44	
Total Disbursements		$38,915.41
Charged to allotment for second half of fiscal period (June 30, 1928)		8,888.05
		$30,027.36

REPORT OF

W. L. SLATE, Director

IN ACCOUNT WITH

Mosquito Elimination Appropriation

(Scetions 2409 and 2410 of General Statutes, Revision of 1918; amended by Chapter 68, Public Acts of 1923)

July 1, 1927—June 30, 1928

RECEIPTS.

State Appropriation	$7,500.00	
Addition	88.46	
Total		$7,588.46

DISBURSEMENTS.

Salary (R. C. Botsford)	$2,500.00	
Labor	4,668.39	
Stationery and Office Supplies	31.40	
Photographic Supplies	3.20	
Miscellaneous Supplies	32.11	
Automobile Oil	3.51	
Oil for Mosquito Spraying	2.00	
Telephone and Telegraph	4.45	
Travel (outlying investigations)	109.65	
" (gasoline)	225.64	
Tools, Machinery and Appliances (new)	34.20	
" " " (repairs)	8.50	
Automobile Repairs and Accessories	229.00	
Buildings and Land (Repairs and Alterations)	166.27	
Insurance (automobile)	59.97	
	$8,078.29	
Transferred to New Mosquito Elimination Fund	287.57	
		8,365.86
Charged to allotment for second half of fiscal period June 30, 1928		777.40
		$7,588.46

REPORT OF

W. L. SLATE, Director

IN ACCOUNT WITH

Tobacco Research Appropriation

(Public Acts, 1921, Chapter 184.)

July 1, 1927—June 30, 1928

RECEIPTS.

State Appropriation	$15,000.00	
Contributions	1,814.24	
Sales of Tobacco	1,860.49	
		$18,674.73

DISBURSEMENTS.

By the State Comptroller on vouchers submitted by W. L. Slate, Director:		
Salaries	$7,400.00	
Labor	6,863.93	
Stationery and Office Supplies	113.71	
Chemicals	111.82	
Laboratory Supplies	93.06	
Photographic Supplies	20.91	
Feeding Stuffs	25.01	
Insecticides and Fungicides	36.93	
Lumber and Small Hardware	31.81	
Miscellaneous Supplies	358.84	
Automobile Oil	28.08	
Fertilizer	512.36	
Telephone and Telegraph	75.07	
Travel (outlying investigations)	317.77	
" (meetings, conferences, etc.)	143.91	
" (gasoline)	89.07	
Freight, Cartage and Express	51.23	
Fuel	531.35	
Electricity	158.69	
Water	54.96	
Furniture and Fixtures (new)	272.77	
" " (repairs)	15.40	
Books, Periodicals and Subscriptions	18.92	
Scientific Apparatus (new)	562.50	
" " (repairs)	2.61	
Automobiles (repairs)	135.41	
Tools, Machinery and Appliances (new)	676.73	
" " " (repairs)	19.84	
Buildings and Land (repairs and alterations)	477.37	
Rent of Land	75.00	
Insurance (automobile and tobacco)	62.78	
		$19,337.84
Charged to allotment for second half of fiscal period June 30, 1928		663.11
		$18,674.73

REPORT OF

W. L. SLATE, Director

IN ACCOUNT WITH

White Pine Blister Rust Appropriation

(Section 2117 of General Statutes, Revision of 1918)

July 1, 1927—June 30, 1928

RECEIPTS.

State Appropriation		$7,500.00	
Refund for Labor	$1,318.88		
Refund for Experimental Work	204.83		
Refund for Camp Meals	7.83		
		1,531.54	
			$9,031.54

EXPENDITURES.

By the State Comptroller on vouchers submitted by W. L. Slate, Director:		
Salaries	$1,646.46	
Labor	7,365.28	
Stationery	31.88	
Lumber and Small Hardware	15.32	
Miscellaneous Supplies	12.72	
Telegraph and Telephone	31.05	
Travel (outlying investigations)	1,271.08	
" (meetings, conferences, etc.)	64.55	
Cartage	43.80	
Publications	5.50	
Furniture and Fixtures	45.00	
Automobiles (new)	657.70	
Tools, Machinery and Appliances (new)	41.16	
Automobiles (repairs)	45.35	
Insurance (automobile)	243.42	
Miscellaneous Contingent Expenses	60.19	
Total Disbursements		$11,580.46
Charged to allotment for second half of fiscal period June 30, 1928		2,548.92
		$9,031.54

Bulletin 296 October, 1928

Connecticut Agricultural Experiment Station
New Haven, Connecticut

Report on Inspection
of
Commercial Fertilizers for 1928

E. M. BAILEY, *Chemist in Charge of the Analytical Laboratory.*

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The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to other applicants as far as the editions permit.

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

OFFICERS AND STAFF

BOARD OF CONTROL

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Press of The Wilson H. Lee Co., New Haven, Conn.

Report on Inspection
of
Commercial Fertilizers
1928

E. M. Bailey,
Chemist in Charge, Analytical Laboratory.

THE FERTILIZER LAW.

The provisions of the Connecticut fertilizer law have been discussed in previous reports but for more ready reference its essential features may be noted here.

Significance of the Term "Commercial Fertilizers."

Explaining what is meant by the term "commercial fertilizers" the law says:

"The term 'commercial fertilizers' shall be construed to mean any and every substance imported, manufactured, prepared or sold for fertilizing or manuring or soil amendment purposes, except barnyard manure and stable manure which have not been artificially treated or manipulated, marl and lime. Cottonseed meal, rapeseed meal, castor pomace and all other vegetable products used as fertilizers, including the ashes of cotton hulls and wood ashes, shall be included as fertilizers within the meaning of this act and separate analysis fees shall be paid on each different grade which is sold or offered for sale in the state. The person responsible for paying the fees above prescribed may deduct from the total tonnage sold such sales of cottonseed meal or other vegetable products as are made to anyone who gives a written certificate on a form supplied by the Connecticut Agricultural Experiment Station stating that the material bought by him was to be used exclusively for feed and not for fertilizer."

Concerning Cottonseed Meal.

Cottonseed meal is a fertilizer within the meaning of the Statute but it is provided that when this product is sold for feeding purposes only, it shall be exempt from the tonnage tax. When sold as a feed, cottonseed meal is subject to registration under the terms of the feed law. By regulation, however, if it is sold exclusively as a fertilizer, or exclusively as a feed it may be registered but once, and under that law which applies.

The status of cottonseed meal under the fertilizer law has been clearly stated in bulletin[1] from this Station from which the following may be quoted:

Registration and analysis fees. "Each brand of cottonseed meal must be registered on forms provided by this Station and an analysis fee of ten dollars paid on it before it is sold, offered or exposed for sale, and on the first day of January annually thereafter."

[1]Bull. of Information No. 9, 1919.

"A distinctive name constitutes a distinct brand. If shipments have different guaranties of composition they are held to be different brands."

Branding or tagging. "Since nitrogen is the only fertilizer ingredient considered in the trade in cottonseed meal no guaranty of phosphoric acid or potash is required. If either is guaranteed by the manufacturer, however, an additional fee of ten dollars must be paid on each element. The statement of composition now legal for feeds may be used hereafter if the percentage of nitrogen is stated.

"Note that the law regarding feeding stuffs forbids the use of metal in attaching tags and requires that each package shall be branded or tagged with the statement required by law."

Duties of shippers. "It is assumed from correspondence with shippers outside the state that they will register the brands which they sell in Connecticut, will pay analysis fees as has been done in the past by manufacturers of commercial fertilizers, and will semi-annually thereafter pay the tonnage fees.

"They will report to this Station their total sales and if they wish, may report what part has been sold for feed exclusively. From the reports of dealers within the state it will be possible to determine quite closely the amounts of each brand actually used as feed.

"In the case the jobber outside the state neglects or refuses to register a brand, the dealer who sells it within the state is responsible under the law."

Duties of dealers. "Dealers are required to file with the director of the Station on July first of each year and semi-annually thereafter a sworn statement of their total sales of each brand of cottonseed meal and the amount of each sold exclusively for feed, during the preceding six months."

Requirements to be Complied with by Sellers of Commercial Fertilizers.

The seller is responsible for the proper labeling of each package, for the registration at the Station of every brand sold by him an for the payment of the analysis fee, before offering for sale,and annually thereafter on January 1st.

The law specifies the information which shall be given on the label as follows:

1. *Weight of each package in pounds.*
2. *Brand name or trade mark.*
3. *Analysis:*
   - (a) *Available phosphoric acid, per cent.*
   - (b) *Total phosphoric acid, per cent.*
   - (c) *Nitrogen, per cent.*
   - (d) *Equivalent ammonia, per cent.*
   - (e) *Potash soluble in water, per cent.*
4. *Name and address of the manufacturer or of the person who is responsible for the statement of the guaranty.*

In the case of bone meal, tankage or other organic products, and in basic slag and mineral phosphates in which a large percentage of the phosphoric acid is not available by laboratory methods, the

phosphoric acid shall be claimed as total phosphoric acid unless it is desired to claim available phosphoric acid instead, in which case the guaranty shall take the form set forth above.

The label may be a tag attached to the package or a statement printed thereon. Percentages shall be minimum percentages only.

The presence of leather in its various forms, wool waste, hair, or any inert nitrogenous material shall be declared on the label unless, by processing, the activity of these materials has been rendered satisfactory as determined by official methods.

When potash is derived from sulphate or carbonate of potash it may be so claimed.

No claim or guaranty for less than 0.82 per cent of nitrogen or for less than 1 per cent of phosphoric acid, or for less than 1 per cent of potash shall be regarded in the registration or analysis of any commercial fertilizer.

The seller must also, on the 1st of January and July, report the tonnage of fertilizer sold within the preceding six months and pay to the director of the Station a tonnage fee of 6 cents per ton. On request, copies of the law and blanks for registration and for tonnage reports will be supplied by the Station.

If, however, proper labeling, registration and payments have been provided for by the manufacturer of the brands or by another responsible person all sellers of such brands are released from the above mentioned requirements. The retailer, therefore, should assure himself that the requirements of the law have been met by the manufacturers of the brands which he handles, or himself be prepared to meet all these requirements.

Precautions to be Observed in Drawing Samples for Analysis.

The analysis of a fertilizer is of no value unless the sample analyzed represents as nearly as possible the stock from which the sample was drawn. The law prescribes the procedure to be followed by authorized agents of this Station when taking official samples for analysis as follows:

"When samples are taken from fertilizers in bags, a tube shall be used, and it shall be inserted at one end of the bag and shall pass substantially the entire length of the bag, so as to take a core of the material being sampled from substantially the entire length of the bag. Samples thus taken from individual bags shall be thoroughly mixed, and the official samples shall be taken from the mixture so drawn by the method known as 'quartering.' Samples of fertilizers taken as herein provided shall be taken from at least five per centum of the separate original unopened packages in the lot, for the mixture from which the official samples shall be taken. If less than one hundred bags are in the lot, at least five bags shall be sampled; if less than five bags, all shall be sampled. Broken packages shall not be sampled."

Gratuitous Analyses.

Under the fertilizer law the Station is charged only with the analysis of samples drawn by its own agents. It does, however, each year analyze a considerable number of samples drawn by individuals, representing stock purchased by them for their own use. The object of the purchaser is to satisfy himself as to whether he has obtained goods of the grade represented and, perhaps, to obtain evidence upon which to base a claim for shortage should the materials not meet their guaranties. The Station assumes no responsibility for the sampling in case of such unofficial samples and can only vouch for the accuracy of the results obtained on the materials as submitted. Since a representative sample is as essential as an accurate analysis in judging the quality of a shipment of fertilizer, it is evident that a satisfactory adjustment will seldom be effected on the basis of an unofficial sample. Notwithstanding certain objections which may be raised to the practice of analyzing samples submitted by individuals, the Station is disposed to continue such work so long as there is evidence that it constitutes a useful service.

REGISTRATIONS FOR 1928.

For 1928, 61 firms and individuals registered at this Station for sale in this State 433 brands of fertilizers. As required by Statute, the brands so registered are listed as follows:

American Agricultural Chemical Company, New Haven Sales Dept., New Haven, Conn.

A.A.C. Acme Fertilizer
A.A.C. Aroostook Potato Manure
A.A.C. Castor Pomace
A.A.C. Complete General Fertilizer
A.A.C. Double Manure Salts
A.A.C. Double A Tobacco Fertilizer
A.A.C. Dry Ground Fish
A.A.C. Gladiator Fertilizer
A.A.C. Grass and Lawn Top Dressing
A.A.C. Ground Tankage
A.A.C. Hi-Grade Tobacco Manure
A.A.C. Monarch Fertilizer
A.A.C. Muriate of Potash
A.A.C. Nitrate of Soda
A.A.C. Old Hickory Fertilizer
A.A.C. Princess Fertilizer
A.A.C. Pulverized Sheep and Goat Manure
A.A.C. Special Ground Bone
A.A.C. Sulphate of Ammonia
A.A.C. Sulphate of Potash
A.A.C. 16% Superphosphate (Acid Phosphate)
A.A.C. Tobacco Ash Element
Agrico Fertilizer for Corn
Agrico Fertilizer for Potatoes
Agrico Fertilizer for Truck
Bowker's All Round Fertilizer
Bowker's Lawn and Garden Dressing
Bowker's Market Garden Fertilizer
Bowker's Potato and Vegetable Phosphate
Bowker's Stockbridge Early Crop Manure
Bowker's Stockbridge Hill and Drill Fertilizer
Bowker's Stockbridge Tobacco Manure
Bowker's Sure Crop Fertilizer
Bradley's Blood, Bone and Potash
Bradley's Complete Manure for Potatoes and Vegetables
Bradley's Complete Tobacco Manure
Bradley's Eclipse Fertilizer
Bradley's Northland Potato Grower
Bradley's Potato Fertilizer
Bradley's Potato Manure
Bradley's XL Superphosphate of Lime
Cottonseed Meal
National Aroostook Special Fertilizer
National Complete Tobacco Fertilizer
National Market Garden Fertilizer
National Pine Tree State Potato Fertilizer
National Premier Potato Manure
Sanderson's Atlantic Coast Mixture
Sanderson's Complete Tobacco Grower
Sanderson's Corn Superphosphate
Sanderson's Formula A
Sanderson's Formula B
Sanderson's Potato Manure

American Cyanamid Company, 535 Fifth Ave., New York City.

Ammo-Phos

Apothecaries Hall Company, Waterbury, Conn.

Acid Phosphate
Basic Slag Phosphate
Bone Meal 3-22
Bone Meal 4-20
Bone and Meat Tankage
Carbonate of Potash
Castor Pomace
Cotton Seed Meal
Dry Ground Fish
Liberty Corn and All Crops, 2-8-2
Liberty Corn, Fruit and All Crops, 2-12-4
Liberty Fish, Bone and Potash, 3-8-3
Liberty High Grade Market Gardeners, 5-8-7
Liberty High Grade Tobacco Manure, 7-3-7
Liberty Home Vegetable Garden Fertilizer
Liberty Lawn Fertilizer
Liberty Onion Special (Potash as Sulphate), 4-8-7
Liberty Potato and General Crops, 4-8-10
Liberty Potato and Market Gardener's Special, 4-8-4
Liberty Potato and Vegetable, 2-8-10
Liberty Special Fertilizer for Fruit, 7-8-6
Liberty Tobacco Special, 5-3-5
Liberty Tobacco Starter
Liberty Top Dresser for Grass and Grain, 10-3½-8
Muriate of Potash
Nitrate Soda
Nitrate Soda and Potash
Precipitated Bone
Sheep Manure
Sulphate Ammonia
Sulphate Potash
Sulphate Potash-Magnesia
Tankage

Armour Fertilizer Works, 50 Broad St., New York City.

Armour's Big Crop Bone Meal 3-48
Armour's Big Crop Fertilizer 2-12-4
Armour's Big Crop Fertilizer 3-8-4
Armour's Big Crop Fertilizer 4-8-4
Armour's Big Crop Fertilizer 4-8-7
Armour's Big Crop Fertilizer 4-6-10
Armour's Big Crop Fertilizer 4-16-4
Armour's Big Crop Fertilizer 5-8-7
Armour's Big Crop Fertilizer 7-11-10
Armour's Big Crop Fertilizer 7-12-7
Armour's Big Crop Fertilizer 8-6-6
Armour's Big Crop Super Phosphate (Acid Phosphate) 16%
Armour's Big Crop Super Phosphate 20%
Armour's Big Crop Tobacco Fertilizer 7-3-7
Armour's Big Crop Tobacco Special 5-3-5
Armour's Castor Pomace 5½%
Armour's Cotton Seed Meal 8%
Armour's Lawn and Garden Grower 6-8-6
Armour's Ground Tankage 9%
Armour's Muriate of Potash 48%

Armour's Nitrate of Soda 18%
Armour's Sheep and Goat Manure 1½-1-2
Armour's Sulphate of Ammonia 25%
Armour's Sulphate of Potash 48%

Ashcraft-Wilkinson Co., Trust Co. of Georgia Bldg., Atlanta, Ga.
"Helmet"
"Monarch"

Atlantic Packing Company, New Haven, Conn.
Atlantic 5-4-16
Atlantic 5-8-7
Atlantic Grain Fertilizer 2-10-2
Atlantic Special Vegetable 4-8-4

The Baker Castor Oil Company, 120 Broadway, New York City.
Castor Pomace

Barrett Company, 40 Rector St., New York City.
Arcadian Nitrate of Soda
Arcadian Sulphate of Ammonia
Sulphate of Ammonia

F. A. Bartlett Tree Expert Co., Stamford, Conn.
Bartlett's Green Tree Food

The Berkshire Chemical Company, Bridgeport, Conn.
Berkshire Castor Pomace
Berkshire Complete Tobacco
Berkshire Dry Ground Fish
Berkshire Economical Grass
Berkshire Fine Ground Bone
Berkshire Grass Special
Berkshire Ground Tankage
Berkshire Long Island Special
Berkshire Market Garden Fertilizer
Berkshire Potato and Vegetable Fertilizer
Berkshire Sheep Manure
Berkshire Super Phosphate (Acid Phosphate)
Berkshire Tobacco Special
Berkshire Tobacco Starter
Berkshire Truck Fertilizer
Carbonate of Potash
High Grade Sulphate Potash
Muriate Potash
Nitrate of Soda
Precipitated Bone Phosphate

Amos D. Bridge's Sons, Incorporated, Hazardville, Conn.
Corn, Onion, Potato and General Purpose
Special Tobacco Fertilizer

F. W. Brode Corp., 119 Madison Ave., Memphis, Tenn.
"Owl Brand," 36% Cotton Seed Meal

A. H. Case & Company, Inc., 965 William St., Buffalo, N. Y.
Par Plus Brand Pulverized Sheep Manure

The E. D. Chittenden Company, Bridgeport, Conn.

Chittenden's Basic Slag
Chittenden's Castor Pomace
Chittenden's Complete Grain
Chittenden's Dry Ground Fish
Chittenden's Fine Ground Bone
Chittenden's High Grade Potato
Chittenden's Potato Special 4% Potash
Chittenden's Special Top Dresser
Chittenden's Tobacco Special
Chittenden's Valley Wrapper Brand
Chittenden's Vegetable and Onion Grower
Special Mixture

Everett B. Clark Seed Company, Milford, Conn., Succeeded by Associated Seed Growers, Inc., New Haven, Conn.

Nitrate of Soda
16% Acid Phosphate
Special Mixture for General Use 4-8-4
Super Phosphate
Special Mixture with 6% Potash 4-8-6
Tip Top Brand

The Conn. Fat Rendering & Fertilizer Corp., West Haven, Conn.

Tankage

Consolidated Rendering Company, 40 North Market St., Boston, Mass.

Castor Pomace
Corenco Sheep Manure
Dry Ground Fish
Ground Bone
Muriate of Potash
Nitrate of Soda
Superphosphate (Acid Phosphate)
Sulphate of Ammonia
Sulphate of Potash
Tankage 6-30
Tankage 9-20

C. & R. Sales Co., Worcester, Mass.

C. & R. Lawn Shrub Fertilizer

The Davey Tree Expert Company, Kent, Ohio.

Davey Shredded Cattle Manure
Davey Tree Food

Eastern States Farmers' Exchange, 38 Lyman St., Springfield, Mass.

Buckland's Formula A 6-2-7 Special Tobacco Mixture
Eastern States Acid Phosphate
Eastern States Calcium Nitrate
Eastern States Dried Ground Fish
Eastern States Fine Bone Meal
Eastern States Ground Animal Tankage
Eastern States Muriate of Potash
Eastern States Nitrate of Potash
Eastern States Nitrate of Soda
Eastern States 0-16-8 Open Formula

Eastern States 3-12-3 Open Formula
Eastern States 4-8-10 Open Formula
Eastern States 4-16-4 Open Formula
Eastern States 5-8-7 Open Formula
Eastern States 5-10-5 Open Formula
Eastern States 8-6-6 Open Formula
Eastern States 8-16-8 Open Formula
Eastern States 8-16-20 Open Formula
Eastern States 10-16-14 Open Formula
Eastern States 10-16-14 (Potash from Sulphate) Open Formula
Eastern States Open Formula 9-3-7 Tobacco Fertilizer
Eastern States Open Formula 10-3-8 Tobacco Fertilizer
Eastern States Precipitated Bone
Eastern States Sulphate of Ammonia
Eastern States Sulphate of Potash
Eastern States Urea

Edward Eggert, 208 State St., Hartford, Conn.
Diamond E. E. Cotton Seed Hull Ashes

Essex Fertilizer Company, 39 North Market St., Boston, Mass.
Essex A1 Super 2-10-2
Essex Complete Manure 5-8-7
Essex Fish Fertilizer For All Crops 3-8-4
Essex Market Garden 4-8-4
Essex Peerless Potato Manure 4-6-10
Essex Tobacco Manure 5-3-5
Essex Top Dressing 7-6-5

Ford Motor Company, Detroit, Michigan.
Ford Ammonium Sulphate

Four Seasons Fertilizer Co., Inc., 135 West 29th St., New York City.
Four Seasons Fertilizer

The L. T. Frisbie Company, New Haven, Conn.
Frisbie's 5-8-7
Frisbie's Corn and Grain Fertilizer 2-10-2
Frisbie's Fine Bone Meal 4-22
Frisbie's Market Garden 4-8-7
Frisbie's Special 3-8-4
Frisbie's Tobacco Grower 5-3-5
Frisbie's Top Dresser
Frisbie's Special Vegetable and Potato Grower 4-8-4

Gash-Stull Company, Chester, Pa.
Young's Formula (8-7-6)

The Grasselli Chemical Company, Cleveland, Ohio.
Grasselli Odorless Plant Food

Humphreys-Godwin Company, Memphis, Tenn.
Bull Brand Cottonseed Meal
Danish Brand Cottonseed Feed
Dixie Brand Cottonseed Meal

International Agricultural Corporation, 38 Chauncy St., Boston, Mass.

Cottonseed Hull Ashes
41% Cottonseed Meal
Cottonseed Meal 43%
I. A. C. Basic Slag
Nitrate of Lime
Tobacco Special 7-6-5
Vuelta Abajo 7-9-8

John Joynt, Lucknow, Ontario, Canada.

Canada Wood Ashes

Spencer Kellogg & Sons, Inc., Buffalo, N. Y.

Castor Pomace

Lowell Fertilizer Company, 40 North Market St., Boston, Mass.

Lowell 5-10-5
Lowell Animal Brand A High Grade Manure For All Crops 3-8-4
Lowell Bone Fertilizer 2-10-2
Lowell Corn and Vegetable 4-8-4
Lowell Market Garden Manure 5-8-7
Lowell Potato Grower 4-6-10
Lowell Tobacco Manure 5-3-5
Lowell Top Dressing 7-6-5

L. B. Lovitt & Company, Memphis, Tenn.

"Lovit Brand" 43% Cottonseed Meal.

The Mapes Formula & Peruvian Guano Co., 270 Madison Ave., New York City.

The Mapes Connecticut Valley Special
The Mapes Corn Manure
The Mapes General Tobacco Manure
The Mapes General Truck Manure
The Mapes General Use Manure
The Mapes Onion Manure
The Mapes Potato Manure
The Mapes Special Trucker
The Mapes Special Trucker "S. P."
The Mapes Tobacco Ash Constituents
The Mapes Tobacco Ash and Starter
The Mapes Tobacco Manure, Wrapper Brand
The Mapes Tobacco Starter Improved
The Mapes Top Dresser
Nitrate of Soda
Pure Fine Ground Bone
Sulphate of Potash

A. G. Markham & Company, Springfield, Mass.

4-8-4
4-6-10
5-8-7

Meech & Stoddard, Inc., Middletown, Conn.

Sheep Manure

Natural Guano Company, Aurora, Illinois.

"Sheep's Head" Pulverized Sheep Manure

New England Fertilizer Company, 40A North Market St., Boston, Mass.

New England Complete Manure 4-6-10
New England Corn Phosphate 2-10-2
New England Market Garden Manure 5-8-7
New England Potato and Vegetable Manure 4-8-4
New England Super, A High Grade Fertilizer For All Crops 3-8-4
New England Tobacco 7-3-7
New England Tobacco Manure 5-3-5

Olds & Whipple, Inc., Hartford, Conn.

Favorite Brand Sheep Manure
High Grade Carbonate of Potash 96/98
High Grade Sulphate of Potash
O. & W. Acid Phosphate
O. & W. Blue Label Tobacco Fertilizer
O. & W. Castor Pomace
O. & W. Complete Market Garden
O. & W. Complete Tobacco Fertilizer
O. & W. Dry Ground Fish
O. & W. Grain and General Crop Fertilizer
O. & W. Grass Fertilizer
O. & W. High Grade Starter and Potash
O. & W. High Grade Tobacco Starter
O. & W. High Grade Vegetable & Potato
O. & W. Nitrate of Potash 90%
O. & W. Nitrate of Soda
O. & W. Precipitated Bone Meal
O. & W. Pure Bone Meal
O. & W. Sulphate of Ammonia

Pacific Manure & Fertilizer Co., 429 Davis St., San Francisco, California.

Groz-It Brand (Pulverized Sheep Manure)

Parmenter & Polsey Fertilizer Company, 41 North Market St., Boston, Mass.

"P & P" "AA" Brand 5-8-7
"P & P" Maine Potato Fertilizer 4-6-10
Parmenter & Polsey Top Dressing 7-6-5

Piedmont Mt. Airy Guano Co., Baltimore, Md.

Harvest Brand 2-8-2
Harvest Brand 3-8-4
Harvest Brand 4-6-10
Harvest Brand 4-8-4
Harvest Brand 5-8-7
Nitrate Soda

Frank S. Platt Co., 450 State St., New Haven, Conn.

Platt's Concentrated Lawn Fertilizer
Platco Special 5-8-7

Premier Poultry Manure Company, 431 So. Dearborn St., Chicago, Illinois.

Premier Brand Poultry Manure
Premier Brand Sheep Manure

The Pulverized Manure Co., 828 Exchange Ave., Union Stock Yard, Chicago, Illinois.

Wizard Brand Cattle Manure
Wizard Brand Pulverized Sheep Manure

Rackliffe Bros. Co., Inc., New Britain, Conn.

Acid Phosphate 16%
Nitrate of Soda
Rackliffe Brand Corn Fertilizer 4-8-4
Rackliffe Brand Potato & Special Vegetable 5-8-7

The Rogers & Hubbard Company, Portland, Conn.

4-8-4
5-8-7
Acid Phosphate
Garden Fertilizer
Hubbard's "Bone Base" Fertilizer for Seeding Down
Hubbard's "Bone Base" Oats and Top Dressing
Hubbard's Pure Raw Knuckle Bone Flour
Hubbard's "Bone Base" Soluble Corn and General Crops Manure
Hubbard's "Bone Base" Soluble Potato Manure
Hubbard's "Bone Base" Soluble Tobacco Manure
Hubbard's Strictly Pure Fine Bone
Muriate of Potash
Nitrate of Soda
Rogers & Hubbard's All Soils-All Crops Fertilizer
Rogers & Hubbard's Climax Tobacco Brand
Rogers & Hubbard's Corn and Grain Fertilizer
Rogers & Hubbard's High Potash Fertilizer
Rogers & Hubbard's Potato Fertilizer
Rogers & Hubbard's Tobacco Grower-Vegetable Formula
Sheep Manure

F. S. Royster Guano Company, 602 Citizens National Bank Bldg., Baltimore, Md.

Cotton Seed Meal
Royster's Comet Guano
Royster's Connecticut Tobacco Guano
Royster's Fine Ground Bone Meal
Royster's 5% Truck Guano
Royster's Gem Guano
Royster's Nitrate of Soda
Royster's Quality Trucker
Royster's Sheep and Goat Manure
Royster's 16% Acid Phosphate
Royster's Top Dresser
Royster's Trucker's Delight
Royster's Valley Tobacco Guano
Royster's Wrapper Brand

M. L. Shoemaker and Co., Inc., Delaware Ave. and Venango St., Philadelphia, Pa.

Bone Meal
Potato Special
"Swift-Sure" Tobacco Starter 4-10-0
"Swift-Sure" 4-8-5 Special Tobacco Formula
Tobacco and General Use

Springfield Rendering Company, Springfield, Mass.

Springfield 3-8-4
Springfield 4-8-4
Springfield 4-8-7
Springfield 5-8-7
Springfield Tobacco Special 5-3-5

Swift & Company Fertilizer Works, Baltimore, Maryland.

Vigoro

Synthetic Nitrogen Products Corp., 285 Madison Ave., New York City.

Calcium Nitrate Basf (Nitrate of Lime)
Calurea
Nitrophoska
Urea Basf (Floranid)

Tennessee Copper & Chemical Corp., Lockland, Cincinnati, Ohio.

Loma

I. P. Thomas & Son Company, 1000 Drexel Building, Philadelphia, Pa.

Castor Pomace
Dairymen's Special 0-10-10
Economy Fertilizer 3-12-3
High Grade Potato Manure 4-8-10
I. P. Thomas 5-8-7
Long Island Special 4-8-7
Muriate of Potash
Nitrate of Soda
Pure Ground Bone
7% Guano 7-6-5
Sheep & Goat Manure
16% Acid Phosphate
Tankage—sold on analysis
Thomas Tobacco Grower 5-4-5
Tip Top Superphosphate 3-10-6
Truckers High Grade Guano 4-8-4
Victor Potash Fertilizer 2-8-5

Triton Oil and Fertilizer Company, 101 Beekman St., New York City.

Triton 4-8-4 Fertilizer
Triton 4-8-7 Fertilizer
Triton 5-8-5 Fertilizer
Triton 5-8-7 Fertilizer

United States Guano Co., care Standard Wholesale Phosphate & Acid Works, Baltimore, Md.

Standard United States Accomac Peninsula King
Standard United States Bone Meal 4-40
Standard United States 3 x 50 Bone Meal
Standard United States 4½ x 45 Bone Meal Raw
Standard United States Evergreen Fish Guano
Standard United States Fish Bone and Potash
Standard United States General Use Guano
Standard United States Grain Grower
Standard United States High Grade Phosphate and Potash

Standard United States Jersey Special
Standard United States Mammoth Potato Grower
Standard United States Muriate of Potash
Standard United States Nitrate of Soda
Standard United States Old Fertility
Standard United States Royal Potato Grower
Standard United States 16% Acid Phosphate
Standard United States Special Potato Grower
Standard United States Star Brand
Standard United States Sulphate of Ammonia
Standard United States Sure Growth
Standard United States 6 x 30 Tankage
Standard United States 9 x 20 Tankage
Standard United States 10% Fish
Standard United States Truckers Fish Guano
Standard United States 5 x 10 x 5
Standard United States 8 x 6 x 6

Virginia-Carolina Chemical Corp., 120 Broadway, New York City.

Bloomaid
V-C Aroostook Potato Grower
V-C Fish and Potash Compound
V-C Phospho-Tobacco
V-C 16% Acid Phosphate
V-C 20% Acid Phosphate
V-C XXXX Fish and Potash

Wessel, Duval & Co., 1 Broadway, New York City.

Nitrate of Soda

The Wilcox Fertilizer Company, Mystic, Conn.

Acid Phosphate
Ground Steamed Bone
Muriate of Potash
Nitrate of Soda
Wilcox Corn Special 3-10-4
Wilcox Dry Ground Fish
Wilcox H. G. Fish and Potash 4-8-4
Wilcox Potato and Vegetable Phosphate 5-8-7
Wilcox 7-6-5 Top Dresser

S. D. Woodruff & Sons, Orange, Conn.

Woodruff's Home Mixed Fertilizer

Worcester Rendering Co., Auburn, Mass.

Prosperity Brand Complete Dressing
Prosperity Brand Corn and Grain Fertilizer
Prosperity Brand Market Garden Fertilizer
Prosperity Brand Potato and Vegetable Fertilizer

INSPECTION OF 1928.

During the past season the Station agent has visited 101 towns and villages in the State and has taken 536 official samples of fertilizers, including all of the registered brands which could be found. These, together with samples submitted by purchasers, and others interested, are classified as follows:

CLASSIFICATION OF FERTILIZERS ANALYZED IN 1928.

	No. of Samples	Page
I. *Containing Nitrogen as the chief active ingredient:*		
Nitrate of Soda	33	18
Calcium Nitrate (Nitrate of Lime)	4	18
Calurea	5	18
Urea	3	19
Sulphate of Ammonia	12	19
Castor Pomace	55	19
Cottonseed Meal	123	20
Linseed Meal	11	20
II. *Containing Phosphoric Acid as the chief active ingredient:*		
Precipitated Bone Phosphate	7	33
Superphosphate (Acid Phosphate)	18	33
Basic Slag	2	37
III. *Containing Potash as the chief ingredient:*		
Carbonate of Potash	16	37
Muriate of Potash	12	37
Sulphate of Potash	18	37
Sulphate of Potash-Magnesia	2	38
Cotton Hull Ashes	28	38
Wood Ashes	7	38
IV. *Containing Nitrogen and Potash:*		
Nitrate of Potash and Soda	2	45
Nitrate of Potash	5	45
V. *Containing Nitrogen and Phosphoric Acid:*		
Dry Ground Fish	39	46
Tankage	12	51
Ground Bone, etc	52	53
VI. *Mixed Fertilizer:*		
Containing Nitrogen and Phosphoric Acid	6	58
Containing Phosphoric Acid and Potash	4	58
Containing Nitrogen, Phosphoric Acid and Potash	265	59
Special and Home Mixtures	50	84
VII. *Miscellaneous fertilizers, amendments, waste products, etc.:*		
Sheep Manure, etc	26	84
Lime, etc	7	84
Other miscellaneous materials	35	84
Collaborative check meals and fertilizers	45	84
Total	904	

I. RAW MATERIALS CHIEFLY VALUABLE FOR NITROGEN.

NITRATE OF SODA.

This raw material as used for fertilizer contains from 91 to 97 per cent of sodium nitrate which is equivalent to 15 to 16 per cent of nitrogen or 18.2 to 19.5 per cent of ammonia. The impurities in it are potassium and magnesium chlorides, sodium sulphate and sodium iodide of which there is, collectively, 2 to 3 per cent.

Nitrate of soda is obtained from the west coast of South America, chiefly from Chili. Until recently it has been practically the sole source of this form of agricultural nitrogen but it now encounters competition from synthetic nitrogen products. However, natural deposits of nitrate are not likely to be exhausted for many years to come and improved methods of production will no doubt enable this natural raw material to maintain an important place in the fertilizer trade.

Guaranties have ranged from 14.7 to 15.2 per cent. All samples, excepting **9557,** have exceeded guaranties by substantial margins, the average nitrogen content being 15.55 per cent. At the prices quoted nitrogen from this source has cost 22.5 cents per pound. Ton prices ranged from $63.00 to $90.00 there being only one quotation at the high figure.

Analyses are given in Table I.

CALCIUM NITRATE.

This is one of the artificial nitrates produced in large quantities where air nitrogen is converted into nitric acid and the nitric acid then treated with lime or limestone to form nitrate of lime. Because it absorbs moisture rapidly it is shipped in drums or in paper lined bags.

The four samples examined were all guaranteed to contain 15 per cent of nitrogen and this figure was met excepting sample **9611** which was 0.2% low. The average retail price is about $65.00 per ton which makes the cost of nitrogen per pound 21.7 cents.

Analyses are given in Table I.

CALUREA.

Calurea is one of the synthetic ammoniates and is a combination of calcium nitrate and urea. About 1/5 of the nitrogen is derived from nitrate and the remainder is in organic form from urea.

Five samples were examined, all guaranteed to contain 34 per cent of nitrogen or 41.3 per cent of ammonia. One sample, **9652,** was considerably deficient and two others were slightly under the guaranty.

The price quoted is about $110.00 per ton which, on the basis of 34 per cent nitrogen, makes the cost of nitrogen per pound 16.2 cents.

Analyses are given in Table I.

UREA.

This synthetic product is made in large quantities in Europe and is obtained by combining synthetic ammonia with pure carbon dioxide. The commercial article offered for fertilizer is generally guaranteed to contain 46 per cent of nitrogen which is equivalent to 55.5 per cent of ammonia. This form of nitrogen is soluble in water and is classed as organic.

Three samples were examined two of which were slightly under guaranties. At $165.00 per ton which is the retail price quoted to us the cost of nitrogen per pound is 17.9 cents.

Analyses are given in Table I.

SULPHATE OF AMMONIA.

This raw material is made almost entirely in this country from sulphuric acid and by-product ammonia, that is, ammonia obtained in the production of coke and illuminating gas. It may be made, and is made on a large scale in Europe, from synthetic ammonia, gypsum and carbon dioxide.

"Arcadian" sulphate of ammonia is specially treated, dried, and screened to remove lumps and to insure good mechanical condition.

This product is generally guaranteed to contain 20.5 per cent of nitrogen which is equivalent to 25 per cent of ammonia. The twelve samples examined equalled or exceeded their guaranties excepting four cases where slight deficiencies were noted. The average nitrogen found was 20.71 per cent. At $60.00 per ton the average price quoted, the cost of nitrogen per pound is 14.5 cents.

Analyses are given in Table II.

CASTOR POMACE.

This raw material is the ground residue left after the removal of oil from the castor bean. Caution should be used in storing it as it is very poisonous to farm animals. It is chiefly valuable for its nitrogen although it contains small amounts of phosphoric acid and potash.

Fifty-five samples were examined and only six failed to equal guaranties. The deficiencies were in most cases negligible, however, only two being in excess of 0.1 per cent and none were in excess of 0.2 per cent.

The average nitrogen found was 4.97 per cent and the average of quoted prices was about $30.00. Nitrogen from this source has cost about 30 cents per pound as compared with 24 cents last year.

Analyses are given in Table III.

COTTONSEED MEAL.

One hundred and twenty-three samples of cottonseed meal, most of them submitted by purchasers, were examined. The average of all for which guaranties were given, and exclusive of three sold under odd guaranties, is 6.56 per cent of nitrogen which is a 41% protein grade.

The classification of samples this year in comparison with similar data for several years past is given in the following summary:

Grade	No. of samples	Average nitrogen per cent	Average nitrogen per cent in 1927	1926	1925
36 per cent protein (5.76 N).....	15	5.75	5.78	5.84	5.79
41 per cent protein (6.58 N).....	71	6.58	6.56	6.60	6.76
43 per cent protein (6.88 N).....	30	6.88	7.05	6.78	7.02
No guaranty or odd guaranty.....	9	...	...	...	...
Total.....	123	6.56	6.61	6.57	6.63

So far as prices are available the range has been from $48.00 to $70.00 per ton and the average $54.00. On this basis nitrogen from this source has cost about 41 cents per pound during the past year.

One hundred and two substantially met or exceeded their guaranties and twenty-one did not.

Analyses are given in Table IV.

LINSEED MEAL.

Eleven samples of linseed meal were analyzed and all were of good quality. The average nitrogen content was 5.65 per cent. Prices quoted ranged from $49.00 to $57.50 and averaged slightly under $55.00 at which figure the cost of nitrogen per pound was about 48 cents.

Analyses are given in Table IV.

TABLE I. ANALYSES OF NITRATE OF SODA, ETC.

Station No.	Manufacturer or Jobber,	Purchased, Sampled or Sent by	Per cent. Nitrogen. Found.	Per cent. Nitrogen. Guaranteed.
	Nitrate of Soda			
869	American Agricultural Chemical Co., New York	Station agent. Stock of Bristol Grain & Supply, Bristol	15.66	15.22
530	American Agricultural Chemical Co., New York	Station agent. Stock of E. N. Austin, Suffield	15.56	15.22
988	Apothecaries Hall Co., Waterbury, Conn	Station agent. Stock of J. A. Glasnap, West Cheshire	15.52	14.80
923	Apothecaries Hall Co., Waterbury, Conn	Edwards & Brewer, West Suffield	15.68	14.80
331	Apothecaries Hall Co., Waterbury, Conn	Hatheway & Steane, Inc., Hartford	15.56	14.80
657	Apothecaries Hall Co., Waterbury, Conn	Hatheway & Steane, Inc., Hartford	15.90	14.80
835	Apothecaries Hall Co., Waterbury, Conn	Hatheway & Steane, Inc., Hartford	15.58	14.80
941	Apothecaries Hall Co., Waterbury, Conn	Hatheway & Steane, Inc., Hartford	15.64	14.80
330	Apothecaries Hall Co., Waterbury, Conn	A. N. Shepard & Son, Hartford	15.48	14.80
996	Armour Fertilizer Works, New York	Station agent. Stock of J. D. Kelsey, Madison	15.76	14.81
549	Berkshire Chemical Co., Bridgeport, Conn	Station agent. Stock of Knowles Lombard, Guilford	15.56	15.00
557	Everett B. Clark Seed Co., Milford, Conn	Station agent at factory	14.40	15.00
889	Consolidated Rendering Co., Boston, Mass	C. R. Burr & Co., Inc., Manchester	15.66	15.22
121	Consolidated Rendering Co., Boston, Mass	Walter T. Clark, Norwich	15.38	15.22
882	Consolidated Rendering Co., Boston, Mass	Station agent. Stock of Laden Bros., Wallingford	15.74	15.22
154	Eastern States Farmers' Exchange, Springfield, Mass.	Station agent. Stock of Ridgewood Farm, No. Haven	15.60	14.80
303	W. R. Grace & Co., New York	American Sumatra Tobacco Co., Bloomfield	15.58	.....
169	W. R. Grace & Co., New York	American Sumatra Tobacco Co., Bloomfield	15.16	.....
170	W. R. Grace & Co., New York	American Sumatra Tobacco Co., Bloomfield	15.80	.....
171	W. R. Grace & Co., New York	American Sumatra Tobacco Co., Bloomfield	15.88	.....
172	W. R. Grace & Co., New York	American Sumatra Tobacco Co., Bloomfield	15.76	.....
914	Mapes Formula & Peruvian Guano Co., New York	Station agent. Stock of Mapes Branch, Hartford	15.52	14.81
911	Olds & Whipple Inc., Hartford, Conn	Station agent at factory	15.76	15.00
482	Piedmont Mt. Airy Guano Co., Baltimore, Md	Station agent. Stock of C. A. Cowles, Plantsville	15.80	15.00

TABLE I. ANALYSES OF NITRATE OF SODA, ETC.—*Concluded.*

Station No.	Manufacturer or Jobber,	Purchased, Sampled or Sent by	Per cent. Nitrogen.	
			Found.	Guaranteed.
	Nitrate of Soda.			
9501	Rackliffe Bros. Co. Inc., New Britain, Conn.	Station agent at factory.	15.68	....
9291	The Rogers & Hubbard Co., Portland, Conn.	Station agent. Stock of W. L. Richmond, New Milford	15.56	14.8
9497	F. S. Royster Guano Co., Baltimore, Md.	Station agent. Stock of F. B. Newton, Plainville.	15.68	15.0
9587	I. P. Thomas & Son, Philadelphia, Pa.	Station agent. Stock of L. M. Benham, Highwood.	15.66	15.0
9060	U. S. Guano Co., Baltimore, Md.	J. A. Barrasso, Andover.	15.38	14.8
8849	U. S. Guano Co., Baltimore, Md.	Station agent. Stock of Frank Libner & Son, Norwalk.	15.24	14.8
9341	Wessel Duval & Co., New York.	Station agent. Stock of F. H. Woodruff & Son, Milford, Ct.	15.66	14.8
9122	Wilcox Fertilizer Co., Mystic, Conn.	Walter T. Clark, Norwich.	15.52	14.7
9353	Wilcox Fertilizer Co., Mystic, Conn.	Station agent at factory.	14.92	14.7
	Calcium Nitrate (Nitrate of Lime)			
9561	International Agricultural Corp., Woburn, Mass.	Station agent. Stock of Lyman Farm, Middlefield.	15.04	15.0
8899	Synthetic Nitrogen Products Corp., New York.	The Allied Tobacco Co., Hartford.	15.22	15.0
9039	Synthetic Nitrogen Products Corp., New York.	Station agent. Stock of J. A. Glasnap, West Cheshire.	15.06	15.0
9611	Synthetic Nitrogen Products Corp., New York.	Station agent. Stock of Tobacco Station, Windsor.	14.80	15.0
	Calurea.			
9652	Synthetic Nitrogen Products Corp., New York.	J. E. Phelps, Suffield.	32.38	34.0
9038	Synthetic Nitrogen Products Corp., New York.	Station agent. Stock of Olds & Whipple, Inc., Hartford.	34.54	34.0
9116	Synthetic Nitrogen Products Corp., New York.	Station agent. Stock of Tobacco Station, Windsor.	34.40	34.0
9331	Synthetic Nitrogen Products Corp., New York.	A. N. Shepard & Son, Hartford	33.78	34.0
9392	Synthetic Nitrogen Products Corp., New York.	Eastern States Farmers' Exchange, Springfield, Mass.	33.80	34.0
	Urea.			
9456	Eastern States Farmers' Exchange, Springfield, Mass.	Station agent. Stock of Chester Beeman, Granby.	45.40	45.2
9037	Synthetic Nitrogen Products Corp., New York.	Station agent. Stock of Olds & Whipple, Inc., Hartford.	45.80	46.0
9115	Synthetic Nitrogen Products Corp., New York.	Station agent. Stock of Tobacco Station, Windsor.	45.84	46.0

TABLE II. ANALYSES OF SULPHATE OF AMMONIA.

Station No.	Manufacturer or Jobber,	Purchased, Sampled or Sent by	Per cent. Nitrogen.	
			Found.	Guaranteed.
3954	American Agricultural Chemical Co., New York	Station agent at factory, West Haven	20.76	20.56
9532	American Agricultural Chemical Co., New York	Station agent. Stock of E. N. Austin, Suffield	20.42	20.56
3992	Apothecaries Hall Co., Waterbury, Conn	Station agent at factory	21.00	20.58
9030	Armour Fertilizer Works, New York	Station agent. Stock of F. A. Bartlett Tree Expert Co., Stamford	21.00	20.56
9546	The Barrett Co., New York	Station agent. Stock of Berkshire Chemical Co., Bridgeport	21.00	20.75
9547	The Barrett Co., New York	Station agent. Stock of Berkshire Chemical Co., Bridgeport	20.70	20.50
3957	Consolidated Rendering Co., Boston, Mass	Station agent. Stock of L. T. Frisbie Co., New Haven	20.68	20.50
9157	Eastern States Farmers' Exchange, Springfield, Mass.	Station agent. Stock of J. A. Sherwood, Bridgeport	20.56	20.55
9059	Olds & Whipple Inc., Hartford, Conn	J. A. Barrasso, Andover	20.50	20.60
9566	Olds & Whipple Inc., Hartford, Conn	Station agent at factory	20.54	20.60
8853	U. S. Guano Co., Baltimore, Md	Station agent. Stock of H. P. Beers, Southport	20.48	20.56
9057	U. S. Guano Co., Baltimore, Md	J. A. Barrasso, Andover	20.92	20.56

TABLE III. ANALYSES OF CASTOR POMACE.

Station No.	Manufacturer or Jobber, Car No. or Mark	Purchased, Sampled or Sent by	Per cent. Nitrogen. Found.	Guaranteed.
	The American Agricultural Chemical Co., New York City.			
8953	.....	Station agent from factory....	4.78	4.53
9318	Car N. Y. C. 247062.....	Spencer Bros., Inc., Suffield....	4.67	4.53
	Apothecaries Hall Co., Waterbury, Conn.			
8982	.....	Station agent from factory.....	4.75	4.52
9610	.....	Station agent. Stock of Tobacco Station, Windsor.....	4.48	4.52
8897	Car No. 17816.....	The Allied Tobacco Co., Hartford.....	5.20	4.52
8922	.....	Edwards & Brewer, West Suffield.....	4.94	4.52
8353	Car No. 10777.....	Hatheway & Steane, Inc., Hartford.....	4.86	4.52
8361	Car No. 11712.....	Hatheway & Steane, Inc., Hartford.....	5.56	4.52
8362	Car No. 12075.....	Hatheway & Steane, Inc., Hartford.....	5.54	4.52
8387	Car No. 20404.....	Hatheway & Steane, Inc., Hartford.....	4.72	4.52
8388	Car No. 13462.....	Hatheway & Steane, Inc., Hartford.....	4.34	4.52
8389	Car No. 12952.....	Hatheway & Steane, Inc., Hartford.....	4.78	4.52
8390	Car No. 20415.....	Hatheway & Steane, Inc., Hartford.....	4.58	4.52
8391	Car No. 10919.....	Hatheway & Steane, Inc., Hartford.....	4.37	4.52
8392	Car No. 17915.....	Hatheway & Steane, Inc., Hartford.....	5.26	4.52
8393	Car No. 11624.....	Hatheway & Steane, Inc., Hartford.....	5.16	4.52
8451	Car No. 17229.....	Hatheway & Steane, Inc., Hartford.....	5.65	4.52
8656	Car No. 30368.....	Hatheway & Steane, Inc., Hartford.....	4.80	4.52
8688	Car No. 20448.....	Hatheway & Steane, Inc., Hartford.....	5.34	4.52
8689	Car No. 11172.....	Hatheway & Steane, Inc., Hartford.....	5.42	4.52
8824	Car No. 11104.....	Hatheway & Steane, Inc., Hartford.....	4.76	4.52
8825	Car No. 10720.....	Hatheway & Steane, Inc., Hartford.....	5.16	4.52

TABLE III. ANALYSES OF CASTOR POMACE—*Continued.*

Station No.	Manufacturer or Jobber, Car No. or Mark	Purchased, Sampled or Sent by	Per cent. Nitrogen. Found.	Per cent. Nitrogen. Guaranteed.
	Apothecaries Hall Co., Waterbury, Conn.			
326	Car No. 11815	Hatheway & Steane, Inc., Hartford	5.56	4.52
327	Car No. 13081	Hatheway & Steane, Inc., Hartford	5.36	4.52
332	Car No. 10432	Hatheway & Steane, Inc., Hartford	4.32	4.52
937	Car No. 97143	Hatheway & Steane, Inc., Hartford	4.65	4.52
329		A. N. Shepard & Son, Hartford	4.92	4.52
336		A. N. Shepard & Son, Hartford	5.43	4.52
	Armour Fertilizer Works, New York City.			
441		Station agent. Stock of A. R. Jones, Wallingford	4.58	4.52
	Baker Castor Oil Co., New York City.			
251	Car No. 17093	American Sumatra Tobacco Co., Bloomfield	4.69	4.50
252	Car No. 17018	American Sumatra Tobacco Co., Bloomfield	4.85	4.50
145		Station agent. Stock of Olds & Whipple, Inc., Hartford	4.92	4.50
	Berkshire Chemical Co., Bridgeport, Conn.			
960		Station agent. Stock of Ira Waters, Brookfield	5.12	4.52
531		Station agent. Stock of E. M. Austin, Suffield	4.96	4.52
371	Car No. 226820	Cullman Bros., Hartford	5.00	4.52
512	Car No. 252384	Cullman Bros., Hartford	5.24	4.52
513	Car No. 252384	Cullman Bros., Hartford	5.18	4.52
514	Car No. 252384	Cullman Bros., Hartford	4.95	4.52
517	Car No. 240356	Cullman Bros., Hartford	4.91	4.52
518	Car No. 240356	Cullman Bros., Hartford	4.88	4.52
524	Car No. 245910	Cullman Bros., Hartford	5.22	4.52
525	Car No. 213402	Cullman Bros., Hartford	4.97	4.52
066	Car No. M. C. 91825	Spencer Bros., Suffield	4.64	4.52
067	Car No. G. N. 33540	Spencer Bros., Suffield	4.82	4.52
068	Car No. P. R. R. 517613	Spencer Bros., Suffield	4.90	4.52
069	Car No. P. R. R. 43189	Spencer Bros., Suffield	4.81	4.52
651		J. E. Phelps, Suffield	4.45	4.52

TABLE III. ANALYSES OF CASTOR POMACE—*Concluded.*

Station No.	Manufacturer or Jobber, Car No. or Mark	Purchased, Sampled or Sent by	Per cent. Nitrogen.	
			Found.	Guaranteed.
	E. D. Chittenden Co., Bridgeport, Conn.			
9600	.....	Station agent. Stock of J. P. Norton, Broad Brook.....	4.61	4.5
	Consolidated Rendering Co., Boston, Mass.			
9161	.....	Station agent. Stock of L. T. Frisbie Co., New Haven.....	5.72	4.5
	Spencer Kellogg & Sons, Buffalo, N. Y.			
9233	.....	Station agent. Stock of H. H. McKnight, Ellington.....	4.65	4.5
	Olds & Whipple Inc., Hartford, Conn.			
9485	.....	Station agent. Stock of H. E. Wells, East Windsor Hill....	4.94	5.0
9393	No. 1.....	H. E. Wells, Warehouse Point..	5.26	5.0
9394	No. 2.....	H. E. Wells, Warehouse Point..	5.33	5.0
9098	Car C. N. J. 36426.....	L. Wetstone & Sons, Inc., Hartford.....	5.19	4.7
9099	Car C. N. W. 91660.....	L. Wetstone & Sons, Inc., Hartford.....	4.98	4.7

TABLE IV. ANALYSES OF COTTONSEED AND LINSEED MEALS.

Station No.	Manufacturer or Jobber, Car No. or Mark	Purchased, Sampled or Sent by	Per cent. Nitrogen. Found.	Per cent. Nitrogen. Guaranteed.
	American Agricultural Chemical Co., New York City	**Cottonseed Meal.**		
519	.....	Station agent at factory.....	5.88	5.76
	Apothecaries Hall Co., Waterbury, Conn.			
986	.....	Station agent at factory.....	6.46	6.58
201	Car No. S. O. U. 155736....	The Allied Tobacco Co., Hartford.....	6.34	6.56
202	Car No. S. O. U. 130013.....	The Allied Tobacco Co., Hartford.....	6.88	6.56
328	Car No. 57701.....	Hatheway & Steane, Inc., Hartford.....	6.83	....
329	Car No. 409501.....	Hatheway & Steane, Inc., Hartford.....	6.71	....
347	Car No. 26782.....	Hatheway & Steane, Inc., Hartford.....	6.87	6.58
348	Car No. 55896.....	Hatheway & Steane, Inc., Hartford.....	6.71	6.58
349	Car No. 330185.....	Hatheway & Steane, Inc., Hartford.....	6.62	6.58
350	Car No. 1048.....	Hatheway & Steane, Inc., Hartford.....	6.58	6.58
351	Car No. 172008.....	Hatheway & Steane, Inc., Hartford.....	6.39	6.58
352	Car No. 154294.....	Hatheway & Steane, Inc., Hartford.....	6.71	6.58
357	Car No. 159218.....	Hatheway & Steane, Inc., Hartford.....	6.60	6.58
358	Car No. 50232.....	Hatheway & Steane, Inc., Hartford.....	6.61	6.58
359	Car No. 55303.....	Hathaway & Steane, Inc., Hartford.....	5.92	6.58
360	Car No. 27478.....	Hatheway & Steane, Inc., Hartford.....	6.60	6.58
394	Car No. 7052.....	Hatheway & Steane, Inc., Hartford.....	6.64	....
447	Car No. 10234.....	Hatheway & Steane, Inc., Hartford.....	6.10	6.58
448	Car No. 47475.....	Hatheway & Steane, Inc., Hartford.....	5.94	6.58
449	Car No. 55923.....	Hatheway & Steane, Inc., Hartford.....	6.48	6.58
450	Car No. 37052.....	Hatheway & Steane, Inc., Hartford.....	6.79	6.58
655	Car No. 163453.....	Hatheway & Steane, Inc., Hartford.....	6.74	6.58

TABLE IV. ANALYSES OF COTTONSEED AND LINSEED MEALS.—*Continued.*

Station No.	Manufacturer or Jobber, Car No. or Mark	Purchased, Sampled or Sent by	Per cent. Nitrogen. Found.	Guaranteed.
	Apothecaries Hall Co., Waterbury, Conn.	**Cottonseed Meal.**		
8684	Car No. 19120	Hatheway & Steane, Inc., Hartford	6.79	6.5
8685	Car No. 51268	Hatheway & Steane, Inc., Hartford	6.43	6.5
8686	Car No. 57978	Hatheway & Steane, Inc., Hartford	6.99	6.5
8687	Car No. 145866	Hatheway & Steane, Inc., Hartford	6.47	6.5
8943	Car No. 34009	Hatheway & Steane, Inc., Hartford	6.81	6.5
	Ashcraft-Wilkinson Co., Atlanta, Ga.			
9598	Helmet	Station agent. Stock of E. A. Root, East Granby	6.54	6.5
9597	Monarch	Station agent. Stock of W. E. Bostwick, New Milford	6.75	6.8
8876	Car A. C. L. 29646	Spencer Bros., Inc., Suffield	7.00	6.8
9014	Car N. Y. 66632	Spencer Bros., Inc., Suffield	6.44	6.5
9017	Car N. Y. 72370 and P. R. R. 37854	Spencer Bros. Inc., Suffield	6.47	6.5
	F. W. Brode Corp., Memphis, Tenn.			
8270	Cold Press Cottonseed Meal	Ed. Eggert, Hartford	4.58	..
9595	Owl Brand 41%	Station agent. Stock of Tobacco Station, Windsor	6.56	6.5
9650	Owl Brand 36%	J. E. Phelps, Suffield	6.58	5.7
	Humphreys-Godwin Co., Memphis, Tenn.			
8896	Dixie, Car No. 515977	The Allied Tobacco Co., Hartford	6.28	6.5
9010	Dixie, Car No. 193844	The Allied Tobacco Co., Hartford	6.50	6.5
9147	Dixie, Car No. B. & O. 193844	The Allied Tobacco Co., Hartford	6.66	6.5
9148	Dixie, Car No. B. & O. 176849	The Allied Tobacco Co., Hartford	6.52	6.5
9149	Dixie, Car L. & N. No. 49693	The Allied Tobacco Co., Hartford	6.57	6.5
8944	Dixie, Car No. 41347	Hatheway & Steane, Inc., Hartford	6.51	6.5
9232	Danish	Station agent. Stock of Amos D. Bridge's Sons, Hazardville	5.67	5.7

TABLE IV. ANALYSES OF COTTONSEED AND LINSEED MEALS.—*Continued.*

	Manufacturer or Jobber, Car No. or Mark	Purchased, Sampled or Sent by	Per cent. Nitrogen. Found.	Per cent. Nitrogen. Guaranteed.
	Humphreys-Godwin Co., Memphis, Tenn.	**Cottonseed Meal.**		
79	Dixie, Car Sou. No. 253049 (Off Color)	A. A. Clark, Windsor	6.56	6.58
80	Dixie, Car C. & A., No. 36732 (Off Color)	A. A. Clark, Windsor	6.56	6.58
84	Bull, Car No. 256123	Cullman Bros., Inc., Hartford	6.74	6.88
85	Bull, Car No. 131981	Cullman Bros., Inc., Hartford	6.84	6.88
86	Bull, Car No. 99263	Cullman Bros., Inc., Hartford	6.65	6.88
15	Bull, Car No. 57752	Cullman Bros., Inc., Hartford	7.02	6.88
16	Bull, Car No. 23062	Cullman Bros., Inc., Hartford	6.52	6.88
19	Bull, Car No. 101022	Cullman Bros., Inc., Hartford	6.79	6.88
20	Bull, Car No. 305291	Cullman Bros., Inc., Hartford	6.80	6.88
21	Bull, Car No. 330868	Cullman Bros., Inc., Hartford	6.77	6.88
22	Bull, Car No. 341282	Cullman Bros., Inc., Hartford	6.88	6.88
23	Bull, Car No. 165243	Cullman Bros., Inc., Hartford	6.66	6.88
26	Bull, Car No. 150145	Cullman Bros., Inc., Hartford	6.89	6.88
27	Bull, Car No. 409874	Cullman Bros., Inc., Hartford	6.82	6.88
28	Bull, Car No. 165472	Cullman Bros., Inc., Hartford	7.02	6.88
00	Bull, Car I. E. No. 342963	Cullman Bros., Inc., Hartford	6.96	6.88
02	Bull, Car No. 166272	Cullman Bros., Inc., Hartford	6.76	6.88
04	Bull, Car No. 60522	Cullman Bros., Inc., Hartford	6.84	6.88
05	Bull, Car No. 166496	Cullman Bros., Inc., Hartford	7.07	6.88
06	Bull, Car No. 169463	Cullman Bros., Inc., Hartford	6.97	6.88
07	Bull, Car No. 166290	Cullman Bros., Inc., Hartford	6.89	6.88
00	Bull, Car No. 30226	Cullman Bros., Inc., Hartford	6.84	6.88
89	Dixie, Car No. 55071	L. B. Haas & Co., Inc., Hartford	6.74	6.58
95	Dixie, Car No. 60296	L. B. Haas & Co., Inc., Hartford	6.84	6.58
42	Dixie, Car No. 135449	L. B. Haas & Co., Inc., Hartford	6.70	6.58
43	Dixie, Car No. 409299	L. B. Haas & Co., Inc., Hartford	6.76	6.58
32	Dixie, Car Sou., No. 304709	Huntington Bros., Windsor	6.66	6.58
33	Dixie, Car C. of G., No.57786	Huntington Bros., Windsor	6.66	6.58
34	Dixie, Car Sou., No. 121643	Huntington Bros., Windsor	6.56	6.58
03	Dixie	H. C. Nelson, West Suffield	6.66	6.58
54	Bull	G. A. Peckham, Suffield	6.56	6.88
31	Dixie	E. H. Rollins, Granby	6.55	6.58
77	Dixie, Car No. 7435	A. N. Shepard & Son, Hartford	6.27	6.58
78	Dixie, Car No. 8054	A. N. Shepard & Son, Hartford	6.42	6.58
79	Danish, Car No. 42746	A. N. Shepard & Son, Hartford	5.81	5.75
26	Danish, Car A. C. L., No. 43846	A. N. Shepard & Son, Hartford	5.60	5.75
15	Dixie, Car C. & F., No. 7064	Spencer Bros., Inc., Suffield	6.72	6.58
70	Bull, Car N. Y., No. 164622 and S. P. 28675	Spencer Bros., Inc., Suffield	7.31	6.88
72	Danish, Car A. C. L. No. 40349	Spencer Bros., Inc., Suffield	5.80	5.76

TABLE IV. ANALYSES OF COTTONSEED AND LINSEED MEALS.—*Continued.*

Station No.	Manufacturer or Jobber, Car No. or Mark	Purchased, Sampled or Sent by	Per cent. Nitrogen.	
			Found.	Guaranteed.
	Humphreys-Godwin Co., Memphis, Tenn.	**Cottonseed Meal.**		
9314	Danish, Car A. C. L. No. 41604	Spencer Bros., Inc., Suffield	5.67	5
9315	Dixie, Car M. & St. L. No. 20578	Spencer Bros., Inc., Suffield	6.62	6
9316	Bull, Car C. N., No. 307465 and S. A. 39754	Spencer Bros., Inc., Suffield	7.00	6
9317	Dixie, Car N. Y., No. 168144 and C. Ga. 51071	Spencer Bros., Inc., Suffield	6.74	6
9469	Danish, C. Ga. No. 57589	Spencer Bros., Inc., Suffield	5.62	5
9470	Danish, Car B. & O., No. 268990	Spencer Bros., Inc., Suffield	6.13	5
9471	Danish, Car C. & K. W., 141906	Spencer Bros., Inc., Suffield	5.69	5
9472	Danish, Car A. C. L. No. 50373	Spencer Bros., Inc., Suffield	5.74	5
9473	Danish, Car C. N. J., No. 17672	Spencer Bros., Inc., Suffield	5.70	5
9474	Danish, Car S. A. L. No. 12611	Spencer Bros., Inc., Suffield	5.70	5
9309	Dixie, Car No. 166221, No. 7	L. Wetstone & Sons, Inc., Hartford	6.58	6
9310	Dixie, Car No. 82911, No. 8	L. Wetstone & Sons., Inc., Hartford	6.48	6
9311	Dixie, Car No. 165007, No. 9	L. Wetstone & Sons, Inc., Hartford	6.63	6
9094	Dixie, Car B.-O., No. 267964, No. 1	L. Wetstone & Sons, Inc., Hartford	6.49	6
9095	Dixie, Car C.R.G., No.57674, No. 2	L. Wetstone & Sons, Inc., Hartford	6.49	6
	International Agricultural Corporation, Boston, Mass.			
8440	Car No. C. Ga. 56996	L. B. Haas & Co., Inc., Hartford	6.61	6
8441	Car No. C. G. 55396	L. B. Haas & Co., Inc., Hartford	6.57	6
9011	Car No. 66246	The Allied Tobacco Co., Hartford	6.91	6
	L. B. Lovitt & Co., Memphis, Tenn.			
9016	"Lovit", Car No. M. & O. 24402	Spencer Bros., Inc., Suffield	7.00	6
9071	"Lovit", Car No. M. & O. 24299	Spencer Bros., Inc., Suffield	7.18	6

TABLE IV. ANALYSES OF COTTONSEED AND LINSEED MEALS.—*Continued.*

	Manufacturer or Jobber, Car No. or Mark	Purchased, Sampled or Sent by	Per cent. Nitrogen.	
			Found.	Guaranteed.
	L. B. Lovitt & Co., Memphis, Tenn.	**Cottonseed Meal.**		
3	"Lovit", Car M. & O. No. 23951	Spencer Bros., Inc., Suffield	6.90	6.88
7	"Lovit, Car No. 15242	Cullman Bros., Inc., Hartford.	6.54	6.56
8	"Lovit", Car No. 15296	Cullman Bros., Inc., Hartford.	6.30	6.56
9	"Lovit", Car. No. 37091	Cullman Bros., Inc., Hartford.	6.47	6.56
0	"Lovit", Car No. 37100	Cullman Bros., Inc., Hartford.	6.63	6.56
	Memphis Cottonseed Products Co., Memphis, Tenn.			
7	Car M. P. No. 22172	Steane, Hartman & Co., Hartford	6.81	6.58
8	Car C. M. No. 83294	Steane, Hartman & Co., Hartford	6.53	6.58
9	Car M. P. No. 6575	Steane, Hartman & Co., Hartford	7.00	6.58
0	Car M. P. No. 120094	Steane, Hartman & Co., Hartford	6.72	6.58
1	Car M. P. No. 8696	Steane, Hartman & Co., Hartford	6.89	6.58
2	Car N. Y. C. No. 96115	Steane, Hartman & Co., Hartford	6.45	6.58
6	Car N. H. No. 71455	Steane, Hartman & Co., Hartford	6.75	6.58
7	Car M. P. No. 120845	Steane, Hartman & Co., Hartford	6.84	6.58
8	Car Sou. No. 155029	Steane, Hartman & Co., Hartford	6.71	6.58
9	Car Ga. No. 19135	Steane, Hartman & Co., Hartford	6.76	6.58
	Olds & Whipple, Inc., Hartford, Conn.			
7	Car No. 56539	L. B. Haas & Co., Hartford	6.74	6.58
	F. S. Royster Guano Co., Baltimore, Md.			
8		Station agent. Stock of Chas. Handel, Glastonbury	6.81	6.88
	Simpson, Hendee & Co., Inc., New York			
2		W. L. Richmond & Son, New Milford	3.40	3.20

TABLE IV. ANALYSES OF COTTONSEED AND LINSEED MEALS.—*Concluded.*

Station No.	Manufacturer or Jobber, Car No. or Mark	Purchased, Sampled or Sent by	Per cent. Nitrogen. Found.	Per cent. Nitrogen. Guaranteed.
	Manufacturer Unknown	**Cottonseed Meal.**		
9130	Car A. C. L. No. 35998	James W. Shea, Feeding Hills	5.85	...
9129	Car M. P. No. 120565	James W. Shea, Feeding Hills	5.70	...
9128	Car A. C. L. No. 32569	James W. Shea, Feeding Hills	5.63	...
9493	.....	E. N. & C. C. Austin, Suffield	6.71	...
	Apothecaries Hall Co., Waterbury, Conn.	**Linseed Meal**		
8354	Car No. 8459	Hatheway & Steane, Inc., Hartford	5.64	...
8452	Car No. 60259	Hatheway & Steane, Inc., Hartford	5.79	...
	Archer-Daniels-Midland Co., Buffalo, N. Y.			
8395	Car No. 60493	Hatheway & Steane, Inc., Hartford	5.65	...
8453	Car No. 9312	Hatheway & Steane, Inc., Hartford	5.64	...
8895	Car LV, No. 60011	The Allied Tobacco Co., Hartford	5.53	5.4
8945	Car No. 76685	Hatheway & Steane, Inc., Hartford	5.65	...
8946	Car No. 114485	Hatheway & Steane, Inc., Hartford	5.75	...
9327	(Suffield)	A. N. Shepard & Son, Hartford.	5.64	...
9335	(Pelton)	A. N. Shepard & Son, Hartford.	5.50	...
	Olds & Whipple, Inc., Hartford, Conn.			
8216	Car No. 60427	L. B. Haas & Co., Hartford	5.62	...
9096	Car N. H. No. 162502(No. 3)	L. Wetstone & Sons, Inc	5.69	5.3

II. RAW MATERIALS CHIEFLY VALUABLE FOR PHOSPHORIC ACID.

PRECIPITATED BONE.

This raw material is a by-product obtained in the manufacture of gelatin and glue stock from bone. Bones are treated with hydrochloric acid and the acid solution then treated with lime or limestone to precipitate the phosphates.

Seven samples were examined all of which exceeded their guaranties in available phosphoric acid. The average was 38 per cent. Only one price quotation was obtained and this affords no very satisfactory basis for calculating the cost of available phosphoric acid in this material. At $56.00 per ton available phosphoric acid cost the purchaser 7.3 cents per pound.

Analyses are given in Table V.

SUPERPHOSPHATE (ACID PHOSPHATE).

This important raw material was formerly called acid phosphate but control officials, agronomists and the fertilizer industry are agreed that the term "acid phosphate" is not properly descriptive and otherwise undesirable and that it should be discontinued. The product is made by treating phosphate rock with sulphuric acid which results in mixture of mono-calcium phosphate and gypsum. The phosphoric acid is in available form and usually present in the proportion of 16 pounds in 100 or 16 per cent.

Eighteen samples were analyzed all of which met or exceeded guaranties. The average for available phosphoric acid found is 17.11 per cent and the average of prices quoted is $22.40 per ton. Available phosphoric acid from this source has, therefore, cost 6.5 cents per pound.

Analyses are given in Table VI.

Sample **8877,** Virginia-Carolina Phospho Tobacco drawn from stock of Stanley-Svea Grain Co., New Britain, was guaranteed to contain 13 per cent of total phosphoric acid. The available found was 12.90 per cent.

TABLE V. ANALYSES OF PRECIPITATED BONE PHOSPHATE.

Station No.	Manufacturer or Wholesale Dealer.	Place of Sampling.	Phosphoric Acid.			
			Citrate-insoluble.	Total.	"Available". Found.	"Available". Guaranteed.
	Sampled by Station.		%	%	%	%
8979	Apothecaries Hall Co., Waterbury	At factory	1.68	39.20	37.52	36.00
9609	Apothecaries Hall Co., Waterbury	Tobacco Station, Windsor	1.35	39.50	38.15	36.00
9405	Berkshire Chemical Co., Bridgeport	At factory	2.25	40.60	38.35	38.00
9212	Eastern States Farmers' Exchange, Springfield, Mass.	H. H. McKnight, Ellington	1.10	39.30	38.20	38.00
8908	Olds & Whipple, Inc., Hartford	At factory	1.88	40.20	38.32	38.00
	Sampled by Purchaser.					
8455	Apothecaries Hall Co., Waterbury	Hatheway & Steane, Inc., Hartford	0.69	37.50	36.81	36.00
9326	Apothecaries Hall Co., Waterbury	A. N. Shepard & Son, Hartford	0.75	39.35	38.60	36.00

TABLE VI. ANALYSES OF SUPERPHOSPHATE (ACID PHOSPHATE).

Station No.	Manufacturer or Wholesale Dealer.	Dealer or purchaser.	Phosphoric Acid.				Station No.
			Citrate Insoluble.	Total.	"Available".		
					Found.	Guaranteed.	
	Sampled by Station.		%	%	%	%	
8866	American Agricultural Chemical Co., New York	Bristol: Bristol Grain & Supply Co.	0.68	19.75	19.07	16.00	8866
8981	Apothecaries Hall Co., Waterbury	Sampled at factory, East Windsor	1.68	17.75	16.07	16.00	8981
9542	Armour Fertz. Works, New York	Seymour: Seymour Grain & Coal Co.	0.40	16.50	16.10	16.00	9542
9548	Berkshire Chemical Co., Bridgeport	Sampled at factory	0.20	18.65	18.45	16.00	9548
9451	E. B. Clark Seed Co., Milford	Sampled at factory	0.40	17.05	16.65	16.00	9451
8883	Consolidated Rendering Co., Boston, Mass.	Wallingford: Laden Bros.	1.70	18.15	16.45	16.00	8883
9152	Eastern States Farmers' Exchange, Springfield, Mass.	North Haven: Ridgewood Farm	1.13	17.30	16.17	16.00	9152
8907	Olds & Whipple, Inc., Hartford.	Sampled at factory	1.70	17.55	15.85	16.00	8907
9499	Rackliffe Bros. Co., Inc., New Britain	Sampled at factory	0.23	16.90	16.67	16.00	9499
9036	The Rogers & Hubbard Co., Portland	Sampled at factory	0.15	17.93	17.78	16.00	9036
9298	F. S. Royster Guano Co., Baltimore, Md.	Madison: J. D. Kelsey	1.35	17.40	16.05	16.00	9298
9582	I. P. Thomas & Son, Philadelphia, Pa.	Hamden: Ira W. Beers	0.86	18.35	17.49	16.00	9582
8855	U. S. Guano Co., Baltimore, Md.	Westport: Rippe Bros.	0.30	16.55	16.25	16.00	8855

TABLE VI. ANALYSES OF SUPERPHOSPHATE (ACID PHOSPHATE)—*Concluded.*

Station No.	Manufacturer or Wholesale Dealer.	Dealer or Purchaser	Phosphoric Acid.				Station No.
			Citrate Insoluble.	Total.	"Available".		
					Found.	Guaranteed.	
	Sampled by Station.		%	%	%	%	
8878	Virginia-Carolina Chemical Co., New York	New Britain: Stanley Svea Grain Co.	0.33	20.30	19.97	20.00	8878
8879	Virginia-Carolina Chemical Co., New York	New Britain: Stanley Svea Grain Co.	0.83	17.85	17.02	16.00	8879
9613	Wilcox Fertilizer Co., Mystic	Woodstock: H. F. Joy	0.63	17.85	17.22	16.00	9613
	Sampled by Purchaser.						
9649	Olds & Whipple, Inc., Hartford	Suffield: J. E. Phelps	1.80	18.20	16.40	16.00	9649
9061	U. S. Guano Co., Baltimore, Md.	Andover: J. A. Barrasso	0.35	18.50	18.15	16.00	9061

BASIC SLAG.

Basic slag is a by-product in the manufacture of steel from phosphatic iron ores. According to the A.O.A.C.[1] definition and standard it shall contain not less than 12 per cent of total phosphoric acid of which not less than 80 per cent shall be "available" by the Wagner method.

Two samples were examined.

Sample **8985** was from stock of Apothecaries Hall Co., drawn at the factory. It was guaranteed 15 available and 17 total phosphoric acid; 16.93 per cent and 18.85 per cent respectively were found.

Sample **9458**, sold by E. D. Chittenden Bridgeport, drawn from stock of Elijah Rogers, Southington, was guaranteed 18 per cent total phosphoric acid and 17.46 per cent was found. No guaranty for available was made but 15.20 per cent was found.

III. RAW MATERIALS CHIEFLY VALUABLE FOR POTASH.

CARBONATE OF POTASH.

In the pure, dry state this salt contains 68.2 per cent of actual potash (K_2O), but commercial grades generally contain from 60 to 65 per cent.

Sixteen samples were analyzed of which only one, **8938**, was notably deficient. The average potash content was 64.8 per cent and at $140.00 per ton potash from this source has cost 10.8 cents per pound.

Analyses are given in Table VII.

MURIATE OF POTASH.

The grades of this salt which we used for fertilizer contain from 48 to 50 per cent of actual potash (K_2O), the potash being largely in the form of chloride.

Twelve samples were examined all of which exceeded 48 per cent of potash and all exceeded guaranties except in case of **9159** which was about 0.5 per cent low. The average potash content was 51.6 per cent and the average ton price quoted was $41.00. Potash from this source cost about 4 cents per pound.

Analyses are given in Table VII.

SULPHATE OF POTASH.

This potash salt contains not less than 48 per cent of potash (K_2O), and not over 2.5 per cent of chlorine according to the tentative definition and standard adopted by the Association of Official Agricultural Chemists.

[1] Assoc. Official Agr. Chemists, Proc. of October, 1925.

Eighteen samples were examined. The average potash content found was 49.1 per cent. No considerable deficiencies were found, the greatest being 0.4 per cent. At $63.00 per ton, the prevailing price quoted, potash from this source cost 6.4 cents per pound.

Analyses given in Table VII.

SULPHATE OF POTASH-MAGNESIA.

Two samples of this material were examined both of which exceeded guaranties by good margins. This salt is generally sold on a guaranty of 26 per cent potash.

Analyses are given in Table VII.

COTTONHULL ASHES.

This raw material is so extremely variable in composition that there is a great deal of difficulty in arriving at a fair settlement between buyer and seller on the basis of chemical analysis. In the same shipment we have found bags which analyzed about 30 per cent potash and others which tested only about ½ as much. Bulk goods arriving in car lots have been in such coarse and lumpy condition in some cases that it was impossible to obtain any adequate sample until the whole lot was ground and mixed.

Twenty-eight samples were examined with the results as shown in Table VII.

WOOD ASHES.

Seven samples of wood ashes have been analyzed and all were of good grade except **8381** which was very inferior, due to leaching.

Analyses are given in Table VII.

Table VII. Analyses of Potash Salts, Etc.

Station No.	Manufacturer or Wholesale Dealer.	Dealer or Purchaser.	Potash. Found.	Potash. Guaranteed.	Station No.
	Carbonate of Potash.		%	%	
	Sampled by Station.				
9194	Apothecaries Hall Co., Waterbury	Sampled at factory	67.52	60.00	9194
9439	Berkshire Chemical Co., Bridgeport	Sampled at factory	66.37	63.00	9439
8912	Olds & Whipple, Inc., Hartford	Sampled at factory	64.98	65.00	8912
	Sampled by Purchaser.				
8927	Apothecaries Hall Co., Waterbury, Conn	Edwards & Brewer, West Suffield	66.62	60.00	8927
8840	Apothecaries Hall Co., Waterbury, Conn., Car No. 137142	Hatheway & Steane, Inc., Hartford	61.80	60.00	8840
8841	Apothecaries Hall Co., Waterbury, Conn., Car No. 9510	Hatheway & Steane, Inc., Hartford	64.60	60.00	8841
8938	Apothecaries Hall Co., Waterbury, Conn., Car No. 76685	Hatheway & Steane, Inc., Hartford	56.54[1]	60.00	8938
8940	Apothecaries Hall Co., Waterbury, Conn., Car No. 80671	Hatheway & Steane, Inc., Hartford	63.24	60.00	8940
9324	Apothecaries Hall Co., Waterbury	A. N. Shepard & Son, Hartford	65.08	60.00	9324
9333	Apothecaries Hall Co., Waterbury	A. N. Shepard & Son, Hartford	65.43	60.00	9333
8445	Berkshire Chemical Co., Bridgeport	L. B. Haas & Co., Hartford	62.64	63.00	8445
8258	A. Klipstein, New York	American Sumatra Tobacco Co., Bloomfield	66.97	.....	8258
8259	A. Klipstein, New York	American Sumatra Tobacco Co., Bloomfield	67.23	.....	8259

[1] Moisture, 15.70%.

TABLE VII. ANALYSES OF POTASH SALTS, ETC.—*Continued.*

Station No.	Manufacturer or Wholesale Dealer.	Dealer or Purchaser.	Potash. Found.	Potash. Guaranteed.	Station No.
	Carbonate of Potash.				
	Sampled by Purchaser.		%	%	
9313	Olds & Whipple, Inc., Hartford	L. Wetstone & Sons, Inc., Hartford	66.66	65.00	9313
9012	Manufacturer unknown	The Allied Tobacco Co., Hartford	66.14	.....	9012
9653	Manufacturer unknown	J. E. Phelps, Suffield	64.85	.....	9653
	Muriate of Potash.				
	Sampled by Station.				
8955	American Agricultural Chemical Co., New York	Sampled at factory, West Haven	51.19	50.00	8955
9529	American Agricultural Chemical Co., New York	E. N. Austin, Suffield	51.50	50.00	9529
8980	Apothecaries Hall Co., Waterbury	Sampled at factory	50.85	50.00	8980
9029	Armour Fertz. Works, New York	F. A. Bartlett Tree Expert Co., Stamford	51.31	48.00	9029
9544	Berkshire Chemical Co., Bridgeport	Sampled at factory	51.40	50.00	9544
8887	Consolidated Rendering Co., Boston, Mass.	Cheshire Reformatory, Cheshire	52.30	50.00	8887
9159	Eastern States Farmers' Exchange, Springfield, Mass.	H. H. McKnight, Ellington	49.46	50.00	9159
9091	The Rogers & Hubbard Co., Portland	Lyman Farm, Middlefield	60.43	50.00	9091
8852	U. S. Guano Co., Baltimore, Md	H. P. Beers, Southport	48.44	48.00	8852
8856	U. S. Guano Co., Baltimore, Md	Rippe Bros., Westport	48.67	48.00	8856
9590	Wilcox Fertilizer Co., Mystic	Sampled at factory	54.34	50.50	9590
	Sampled by Purchaser.				
9054	U. S. Guano Co., Baltimore, Md	J. A. Barrasso, Andover	49.78	48.00	9054

TABLE VII. ANALYSES OF POTASH SALTS, ETC.—*Continued.*

Station No.	Manufacturer or Wholesale Dealer.	Dealer or Purchaser.	Potash. Found.	Potash. Guaranteed.	Station No.
	Sulphate of Potash.				
	Sampled by Station.		%	%	
8951	American Agricultural Chemical Co., New York	Sampled at factory, West Haven	50.30	48.00	8951
9533	American Agricultural Chemical Co., New York	E. N. Austin, Suffield	49.22	48.00	9533
8994	Apothecaries Hall Co., Waterbury	Sampled at factory	49.28	48.00	8994
9447	Armour Fertz. Works, New York	John Sestakanskas, Granby	48.94	48.00	9447
9543	Berkshire Chemical Co., Bridgeport	Sampled at factory	48.83	48.00	9543
8961	Consolidated Rendering Co., Boston, Mass.	L. T. Frisbie Co., New Haven	48.82	48.00	8961
8906	Olds & Whipple, Inc., Hartford	Sampled at factory	48.45	48.65	8906
9618	Olds & Whipple, Inc., Hartford	Sampled at factory	50.76	48.65	9618
	Sampled by Purchaser.				
8925	Apothecaries Hall Co., Waterbury	Edwards & Brewer, West Suffield	49.05	48.00	8925
8837	Apothecaries Hall Co., Waterbury, Car No. 10432	Hatheway & Steane, Inc., Hartford	50.01	48.00	8837
8838	Apothecaries Hall Co., Waterbury, Car No. 86709	Hatheway & Steane, Inc., Hartford	47.60	48.00	8838
8839	Apothecaries Hall Co., Waterbury, Car No. 180284	Hatheway & Steane, Inc., Hartford	49.72	48.00	8839
8939	Apothecaries Hall Co., Waterbury, Car No. 76685	Hatheway & Steane, Inc., Hartford	49.58	48.00	8939
9325	Apothecaries Hall Co., Waterbury (Suffield)	A. N. Shepard & Son, Hartford	48.57	48.00	9325
9332	Apothecaries Hall Co., Waterbury (Pelton)	A. N. Shepard & Son, Hartford	47.86	48.00	9332
8065	Hollingshurst Co., New York, Car No. 566200.	American Sumatra Tobacco Co., Bloomfield	48.59	.....	8065
8066	Hollingshurst Co., New York, Car No. 3255	American Sumatra Tobacco Co., Bloomfield	48.21	.....	8066

TABLE VII. ANALYSES OF POTASH SALTS, ETC.—*Continued.*

Station No.	Manufacturer or Wholesale Dealer.	Dealer or Purchaser.	Potash. Found.	Potash. Guaranteed.	Station No.
	Sulphate of Potash. *Sampled by Purchaser.*		%	%	
7900	Olds & Whipple, Inc., Hartford	American Sumatra Tobacco Co., Bloomfield	49.07	48.65	7900
	Sulphate of Potash and Magnesia. *Sampled by Station.*				
8952	American Agricultural Chemical Co., N. Y.	Sampled at factory, West Haven	31.74	26.00	8952
8995	Apothecaries Hall Co., Waterbury	Sampled at factory	27.96	26.00	8995
	Cotton Hull Ashes. *Sampled by Station.*				
8573	Ed Eggert, Hartford, Car No. R. I. 61821	American Agricultural Chemical Co., West Haven	26.81	.....	8573
8699	Ed. Eggert, Hartford	American Agricultural Chemical Co., West Haven	30.41	.....	8699
8773	Ed. Eggert, Hartford, Car R. I. No. 261016	American Agricultural Chemical Co., West Haven	34.52	.....	8773
8774	Ed. Eggert, Hartford, Car R. I. No. 261016	American Agricultural Chemical Co., West Haven	35.57	.....	8774
8164	Ed. Eggert, Hartford	L. B. Haas & Co., Hartford	16.03	.....	8164
9221	International Agricultural Corp., Boston, Mass.	L. B. Haas & Co., Hartford	18.46	.....	9221
9113	International Agricultural Corp., Boston, Mass.	J. E. Shepard, So. Windsor	18.19	.....	9113

TABLE VII. ANALYSES OF POTASH SALTS, ETC.—*Continued.*

Station No.	Manufacturer or Wholesale Dealer.	Dealer or Purchaser.	Potash. Found.	Potash. Guaranteed.	Station No.
	Cotton Hull Ashes.		%	%	
	Sampled by Station.				
9220	International Agricultural Corp., Boston, Mass.	J. E. Shepard, So. Windsor	12.36[1]	.....	**9220**
9114	International Agricultural Corp., Boston, Mass.	Spencer Bros., Suffield	21.92	.....	**9114**
	Sampled by Purchaser.				
9643	F. W. Brode Co., Memphis, Tenn	J. B. Stewart, Windsor	21.69	.....	**9643**
9707	F. W. Brode Co., Memphis, Tenn	J. B. Stewart, Windsor	23.38	.....	**9707**
8398	Ed. Eggert, Hartford	The Allied Tobacco Co., Hartford	16.92	.....	**8398**
8921	Ed. Eggert, Hartford, Car No. 156355	Edwards & Brewer, West Suffield	28.61	.....	**8921**
9365	Ed. Eggert, Hartford, Car SL&SF No. 129344	P. J. Anderson, Windsor	31.98	.....	**9365**
9366	Ed. Eggert, Hartford, Car R. I. No. 350135	P. J. Anderson, Windsor	29.16	.....	**9366**
9367	Ed. Eggert, Hartford, Car K.C.M.& O., No. 6299	P. J. Anderson, Windsor	39.27	.....	**9367**
9634	Ed. Eggert, Hartford	Amos D. Bridge's Sons, Hazardville	32.48	.....	**9634**
8199	Ed. Eggert, Hartford	Ed. Eggert, Hartford	25.86	.....	**8199**
7761	Ed. Eggert, Hartford	L. B. Haas & Co., Inc., Hartford	25.70	.....	**7761**
7765	Ed. Eggert, Hartford	L. B. Haas & Co., Inc., Hartford	22.04	.....	**7765**
8165	Ed. Eggert, Hartford (Light Gray)	L. B. Haas & Co., Inc., Hartford	11.45	.....	**8165**
8166	Ed. Eggert, Hartford (Dark Gray)	L. B. Haas & Co., Inc., Hartford	11.78	.....	**8166**
8167	Ed. Eggert, Hartford (Brown)	L. B. Haas & Co., Inc., Hartford	28.97	.....	**8167**
9127	Ed. Eggert, Hartford	Will Hayes, Tariffville	16.89	.....	**9127**
9319	Ed. Eggert, Hartford	Spencer Bros., Inc., Suffield	32.25	.....	**9319**
9690	Olds & Whipple, Inc., Hartford	The Otee Tobacco Corp., Windsor	27.85	.....	**9690**

[1] Contained 21.5% moisture.

TABLE VII. ANALYSES OF POTASH SALTS, ETC.—*Concluded.*

Station No.	Manufacturer or Wholesale Dealer.	Dealer or Purchaser.	Potash. Found.	Potash. Guaranteed.	Station No.
	Cotton Hull Ashes. *Sampled by Purchaser.*		%	%	
9628	Olds & Whipple, Inc., Hartford, Car 40438....	J. B. Stewart, Windsor.....	21.41	.....	9623
9723	Olds & Whipple, Inc., Hartford, Car 252942...	J. B. Stewart, Windsor.....	31.28	.....	9728
	Wood Ashes. *Sampled by Purchaser.*				
8385	John Joynt, Lucknow, Canada, Car No. 124904	Hatheway & Steane, Inc., Hartford....	5.82	3.00	8385
8386	John Joynt, Lucknow, Canada, Car No. 93276.	Hatheway & Steane, Inc., Hartford....	5.03	3.00	8386
8651	John Joynt, Lucknow, Canada, Car No. 209938	Hatheway & Steane, Inc., Hartford....	5.30	3.00	8651
8345	John Joynt, Lucknow, Canada.....	John B. Stewart, Windsor.....	5.17	3.00	8345
9312	John Joynt, Lucknow, Canada.....	L. W. Wetstone & Sons, Hartford.....	7.50	3.00	9312
8918	Manufacturer unknown.....	Benj. Fenn, Milford.....	7.26	.....	8918
8381	Manufacturer unknown.....	Henry Lanz, Ellington.....	1.08[1]	.....	8381

[1] Dry basis. Contained 20.35% moisture as received.

IV. RAW MATERIALS CONTAINING NITROGEN AND POTASH.

Seven samples of this group of materials have been examined, four taken by the Station agent and three sent by purchasers.

9504. Nitrate of Soda and Potash. Apothecaries Hall Co., Waterbury. Sampled by Station agent, stock of Barnes & Co., Wallingford.

9769. Nitrate of Soda and Potash. Wilcox Fertilizer Co., Mystic, Conn. Sampled by Station agent at factory.

8910. O & W Nitrate of Potash 90%. Olds & Whipple, Inc., Hartford, Conn. Sampled by Station agent at factory.

9117. Nitrate of Potash (for experiment). Synthetic Nitrogen Products Co., New York. Sampled by Station agent from stock of Tobacco Station, Windsor.

8444. Nitrate of Potash. W. R. Grace & Co., N. Y. Submitted by L. B. Haas & Co., Inc., Hartford.

9089. Nitrate of Potash. Manufacturer unknown. Submitted by Cullman Bros., Hartford.

9648. Nitrate of Potash. Olds & Whipple, Inc., Hartford. Submitted by J. E. Phelps, Suffield.

TABLE VIII. ANALYSES OF NITRATE OF SODA AND POTASH, ETC.

Station No.	**9504**	**9769**	**9117**	**8444**	**9089**	**9648**	**8910**
	%	%	%	%	%	%	%
Nitrogen:							
found.....	14.84	14.63	13.28	15.00	13.44	12.08	12.04
guaranteed...	14.80	14.72	....	....	....	12.00	12.00
Equivalent to ammonia:							
found.....	18.04	17.79	16.15	18.24	16.34	14.69	14.64
guaranteed...	18.00	17.90	....	....	....	14.50	14.50
Potash:							
found.....	14.08	11.70[1]	45.34	15.29	46.76	41.19	41.00
guaranteed...	10.00	11.80	....	....	....	41.00	41.00

[1] Chlorine 0.46%.

V. RAW MATERIALS CONTAINING NITROGEN AND PHOSPHORIC ACID.

DRY GROUND FISH.

This raw material is made from non-edible fish and from the offal from fish canneries. Oil is removed by steaming and pressing and the residue then dried and ground.

Thirty-nine samples were examined, in most cases samples being submitted by purchasers.

This material is usually sold on a guaranty of 8.20 per cent of nitrogen and 5 or 6 per cent. of phosphoric acid. The average nitrogen content of all samples was 8.6 per cent and the average phosphoric acid found was about 5 per cent.

The proportion of nitrogen in the form of ammonia salts was suspiciously high in a number of these samples and microscopic examinations confirmed the conclusion that ammonium sulphate was present. While the purchaser has received the total amount of nitrogenous plant food guaranteed to him he has not received it in the form in which he contracted to purchase it. Nitrogen in the form of ammonium sulphate has been bought this year for about 14.5 cents per pound whereas organic nitrogen in dry ground fish, making due allowance for the phosphoric acid present, has cost the purchaser about 44 cents per pound. *The sale of a mixture of ammonium sulphate and dry ground fish, as and for dry ground fish, constitutes the sale of an adulterated article.*

There should be no occasion to reinforce high grade dry ground fish which normally contains from 8 to 10 per cent of nitrogen. The increasing demand for fish, bone and tankage for animal and poultry feeding, for which purposes these materials are said to command better prices than for fertilizer purposes, suggests a possible reason for "stretching" the supply of high grade fish as much as possible or for using inferior materials reinforced with inorganic ammoniates to make a mixture appear high grade. However, since our investigation indicates that all of the samples of adulterated fish which we have found this year came from one source, there is no good reason to believe that the sale of spurious fish fertilizer is at all general.

Dry ground fish will ordinarily contain small amounts of ammonia nitrogen. Thus 115 samples examined over a period of three years showed an average ammonia nitrogen content of 0.30 per cent and rarely exceeded 1 per cent in any case. The average total nitrogen content for the series was 8.6 per cent. In general it may be expected that animal proteins will yield ammonia nitrogen to the extent of from 6 to 10 per cent of the total nitrogen content when completely hydrolyzed by laboratory methods. Fish protein according to analyses by Osborne and Hyle[1] yielded 1.09

[1] Am. Jour. Physiol., **23**, 81, 1908.

per cent of such nitrogen which was 5.85 per cent of the total nitrogen present. The acidulation of fish in commercial practice however, is not at all likely to produce the extent of hydrolysis obtained in laboratory procedure.

In the series of commercial samples examined this year 20 showed substantial or large amounts of ammonium sulphate and in 19 there was no evidence of excessive ammonia nitrogen and no ammonium sulphate could be detected by microscopic examination. Of the 20 samples showing ammonium sulphate the average proportion of ammonia nitrogen was 43 per cent of the total nitrogen and the maximum proportion was 52 per cent. Of the samples presumed to be genuine the average proportion of ammonia nitrogen was 2.6 per cent of the total and the maximum was a little over 10 per cent.

We have no information as to whether or not the fish examined this year was acidulated but in any case the data just given are pertinent to the issue involved.[1]

Of the samples listed in Table IX, 8155 to 8250 inclusive represented sales by J. W. Wilcox of Mystic, the fish being supplied, according to our information, by the Smith-Douglas Co. of Norfolk, Va. Other samples representing goods obtained through the above named jobber or directly from the Norfolk concern were 9550, E. D. Chittenden Co.; 8898, 9328, 9337, Apothecaries Hall Co.; and 8267, 8268, 8601 and 8603, Berkshire Chemical Co. These samples contained ammonium sulphate sufficient to supply from 10 to 40 per cent of the total nitrogen making due allowance for the ammonia nitrogen ordinarily found in fish fertilizer.

We have no evidence to warrant the conclusion that local dealers were aware of the spurious character of these goods and it is only fair to add that as soon as they were advised of our findings they took immediate steps to make adjustments with their purchasers by means of suitable rebates to cover the difference in cost between inorganic and organic ammoniates.

[1] The following experiment serves to give some idea of the extent to which nitrogen transformation may occur when fish is acidulated commercially.

Fish containing 9.5 per cent of total nitrogen and .08 per cent of ammonia nitrogen was moistened thoroughly with 50 per cent sulphuric acid and allowed to stand at room temperature for one week. Ammonia nitrogen determined at that time was found to be 0.33 per cent. This experiment represents more vigorous treatment than obtains in commercial practice because the entire sample came into intimate contact with the acid.

TABLE IX. ANALYSES OF DRY GROUND FISH.

Station No.	Manufacturer or Wholesale Dealer.	Dealer or Purchaser.	Nitrogen.		Ammonia equivalent to total nitrogen.	Phosphoric Acid.		Station No.
			Total found.	Total Guaranteed		Total found.	Total Guaranteed.	
	Sampled by Station.		%	%	%	%	%	
9379	American Agricultural Chemical Co., New York	Spencer Bros., Suffield	8.72	8.23	10.60	8.50	6.00	9379
9528	American Agricultural Chemical Co., New York	E. N. Austin, Suffield	8.92	8.23	10.84	8.52	6.00	9528
8983	Apothecaries Hall Co., Waterbury	Sampled at factory	9.83	8.20	11.95	6.55	5.00	8983
9545	Berkshire Chemical Co., Bridgeport	Sampled at factory	8.26	8.22	10.04	5.99	6.00	9545
9550	E. D. Chittenden Co., Bridgeport	J. P. Norton, Broad Brook	8.07	8.00	9.81	3.08	6.00	9550
9452	Consolidated Rendering Co., Boston, Mass	John P. Mason, Warehouse Point	8 31	8 22	10 10	8 03	6 40	9452
9022	Olds & Whipple, Inc., Hartford	Sampled at factory	9 48	8 23	11.53	7.48	5.00	9022
8857	U. S. Guano Co., Baltimore, Md	H. D. Peters, Highwood	8 01	8 22	9 74	6 28	....	8857
9354	Wilcox Fertilizer Co., Mystic	Sampled at factory	8 21	8.24	9.98	6.08	6.00	9354
	Sampled by Purchaser.							
8898	Apothecaries Hall Co., Waterbury	The Allied Tobacco Co., Hartford	8.02	8.20	9.75	3.83	5.00	8898
8926	Apothecaries Hall Co., Waterbury	Edwards & Brewer, West Suffield	8.48	8.20	10.31	4.53	5.00	8926
8330	Apothecaries Hall Co., Waterbury	Hatheway & Steane, Inc., Hartford	8.36	8.20	10.16	4.22	5.00	8330
8396	Apothecaries Hall Co., Waterbury	Hatheway & Steane, Inc., Hartford	7.92	8.20	9.63	4.58	5.00	8396
8454	Apothecaries Hall Co., Waterbury	Hatheway & Steane, Inc., Hartford	8.26	8.20	10.04	4.59	5.00	8454
8690	Apothecaries Hall Co., Waterbury	Hatheway & Steane, Inc., Hartford	7.80	8.20	9.48	4.25	5.00	8690

TABLE IX. ANALYSES OF DRY GROUND FISH.—*Continued.*

Station No.	Manufacturer or Wholesale Dealer.	Dealer or Purchaser.	Nitrogen.		Ammonia equivalent to total nitrogen.	Phosphoric Acid.		Station No.
			Total found.	Total Guaranteed.		Total found.	Total Guaranteed.	
	Sampled by Purchaser.		%	%	%	%	%	
8817	Apothecaries Hall Co., Waterbury....	Hatheway & Steane, Inc., Hartford	8.41	8.20	10.22	4.10	5.00	8817
8818	Apothecaries Hall Co., Waterbury....	Hatheway & Steane, Inc., Hartford	8.23	8.20	10.01	3.60	5.00	8818
8834	Apothecaries Hall Co., Waterbury....	Hatheway & Steane, Inc., Hartford	8.56	8.20	10.41	3.85	5.00	8834
8936	Apothecaries Hall Co., Waterbury....	Hatheway & Steane, Inc., Hartford	7.96	8.20	9.68	3.63	5.00	8936
9328	Apothecaries Hall Co., Waterbury....	A. N. Shepard & Son, Hartford...	8.26	8.20	10.04	5.00	5.00	9328
9337	Apothecaries Hall Co., Waterbury....	A. N. Shepard & Son, Hartford...	8.77	8.20	10.66	4.30	5.00	9337
9526	The Berkshire Chemical Co., Bridgeport.....	E. N. & C. C. Austin, Suffield.....	7.90	8.22	9.60	5.85	6.00	9526
8267	The Berkshire Chemical Co., Bridgeport.....	L. B. Haas & Co., Inc., Hartford..	9.74	8.22	11.84	6.84	6.00	8267
8268	The Berkshire Chemical Co., Bridgeport.....	L. B. Haas & Co., Inc., Hartford..	9.75	8.22	11.85	7.37	6.00	8268
9097	Olds & Whipple, Inc., Hartford.....	L. W. Wetstone & Sons, Inc., Hartford.....	9.11	8.23	11.08	8.70	5.00	9097
8155	J. Waterman Wilcox, Mystic.....	American Sumatra Tobacco Co., Bloomfield.....	8.72	....	10.60	3.05	....	8155
8156	J. Waterman Wilcox, Mystic.....	American Sumatra Tobacco Co., Bloomfield.....	8.30	....	10.09	3.71	....	8156
8157	J. Waterman Wilcox, Mystic.....	American Sumatra Tobacco Co., Bloomfield.....	8.68	....	10.55	3.83	....	8157

TABLE IX. ANALYSES OF DRY GROUND FISH.—*Concluded.*

Station No.	Manufacturer or Wholesale Dealer.	Dealer or Purchaser.	Nitrogen.		Ammonia equivalent to total nitrogen.	Phosphoric Acid.		Station No.
			Total found.	Total Guaranteed		Total found.	Total Guaranteed.	
	Sampled by Purchaser.		%	%	%	%	%	
8158	J. Waterman Wilcox, Mystic	American Sumatra Tobacco Co., Bloomfield	8.58	....	10.43	3.32	....	8158
8159	J. Waterman Wilcox, Mystic	American Sumatra Tobacco Co., Bloomfield	8.36	....	10.16	3.51	....	8159
8160	J. Waterman Wilcox, Mystic	American Sumatra Tobacco Co., Bloomfield	8.36	....	10.16	3.48	....	8160
8245	J. Waterman Wilcox, Mystic	American Sumatra Tobacco Co., Bloomfield	8.52	....	10.36	2.96	....	8245
8246	J. Waterman Wilcox, Mystic	American Sumatra Tobacco Co., Bloomfield	8.22	....	9.99	3.05	....	8246
8247	J. Waterman Wilcox, Mystic	American Sumatra Tobacco Co., Bloomfield	8.91	....	10.83	2.82	....	8247
8248	J. Waterman Wilcox, Mystic	American Sumatra Tobacco Co., Bloomfield	8.82	....	10.72	2.70	....	8248
8249	J. Waterman Wilcox, Mystic	American Sumatra Tobacco Co., Bloomfield	8.02	....	9.75	3.52	....	8249
8250	J. Waterman Wilcox, Mystic	American Sumatra Tobacco Co., Bloomfield	8.64	....	10.50	3.05	....	8250
8601	Car No. 34983	Cullman Bros., Hartford	10.18	....	12.38	7.18	....	8601
8603	Car No. P. A. 533730	Cullman Bros., Hartford	9.78	....	11.89	7.48	....	8603

TANKAGE.

This raw material is derived from refuse meat and bone. The refuse is treated with steam and then pressed to remove fat after which it is dried and ground. The composition depends upon the proportions of meat and of bone which are present; high nitrogen and low phosphoric acid indicates a preponderance of meat while the reverse is true if bone predominates. High grade tankage contains 8 to 10 per cent of nitrogen and 5 to 10 per cent of phosphoric acid.

Garbage tankage is less valuable as a fertilizer and generally contains not over 3.5 per cent. of nitrogen and not over 5 per cent of phosphoric acid.

Twelve samples were analyzed. All met nitrogen guaranties excepting **8683, 8858** and **9606** which were from 0.3 to 0.4 per cent low. Phosphoric acid guaranties were met or exceeded excepting **9135** which was considerably low.

Microscopic examinations were made to discover inorganic ammoniates and mineral phosphates if present. In two or three samples both of those substances were found but the amounts did not appear to be sufficient to materially enhance either the nitrogen or the phosphoric acid.

Analyses are found in Table X.

TABLE X. ANALYSES OF TANKAGE.

Station No.	Manufacturer	Dealer or Purchaser.	Nitrogen.		Ammonia equivalent to total nitrogen.	Phosphoric Acid.		Mechanical Analysis.		Station No.
			Total found.	Total guaranteed.		Total found.	Total guaranteed.	Finer than 1–50 inch.	Coarser than 1–50 inch.	
	Sampled by Station.		%	%	%	%	%	%	%	
8956	American Agricultural Chemical Co., New York	Sampled at factory	7.78	7.40	9.46	10.53	9.15	42.0	58.0	8956
8987	Apothecaries Hall Co., Waterbury	J. A. Glasnap, West Cheshire	4.03	3.29	4.90	20.25	20.00	36.0	64.0	8987
8993	Apothecaries Hall Co., Waterbury	Sampled at factory	8.38	7.40	10.19	9.25	3.00	51.5	48.5	8993
9612	Armour Fertilizer Works, New York	Geo. R. Davidson, So. Meriden	7.47	7.40	9.08	11.13	6.87	50.5	49.5	9612
9438	Berkshire Chemical Co., Bridgeport	Sampled at factory	7.34	7.40	8.92	8.78	6.86	35.0	65.0	9438
9135	Connecticut Fat Rendering & Fertilizer Co., New Haven	Sampled at factory	3.99	3.29	4.85	21.10	25.00	40.0	60.0	9135
8962	Consolidated Rendering Co., Boston, Mass	L. T. Frisbie Co., New Haven	7.81	7.41	9.50	10.83	9.15	33.0	67.0	8962
8963	Consolidated Rendering Co., Boston, Mass	L. T. Frisbie Co., New Haven	5.17	4.92	6.29	14.55	14.00	24.0	76.0	8963
8683	U. S. Guano Co., Baltimore, Md	Geo. S. Jennings, Southport	7.02	7.40	8.53	10.15	9.15	38.0	62.0	8683
8858	U. S. Guano Co., Baltimore, Md	H. D. Peters, Highwood	7.03	7.40	8.55	9.48	9.15	42.0	58.0	8858
9606	U. S. Guano Co., Baltimore, Md	J. B. Lewis, Southington, Conn	7.10	7.40	8.63	10.65	9.15	43.0	57.0	9606
	Sampled by Purchaser.									
8890	L. T. Frisbie Co., New Haven	C. R. Burr & Co., Inc., Manchester	5.16	....	6.27	14.00	....	26.0	74.0	8890

BONE MEAL.

Raw Bone Meal or Raw Ground Bone is the product made by drying and grinding animal bones which have not been previously steamed under pressure.

Steamed Bone Meal or Steamed Ground Bone is the product made by steaming bones under pressure after which they are dried and ground.

Steamed bone contains about one-half as much nitrogen as raw bone.

Fifty-two samples were examined, twenty-four of which were official samples drawn by the station agent. There were only three deficiencies found in nitrogen and four in total phosphoric acid.

There has been a scarcity of domestic bone during the past year and manufacturers have in some cases been obliged to fill their needs from foreign markets.

Although guaranties in nearly all cases were met or exceeded it was easy to see that some of the samples were not pure bone. This led us to examine microscopically all of the official samples, and many of those submitted by purchasers. All of the samples from stock sold by the U. S. Guano Company contained inorganic ammoniates or mineral phosphates or both. As in the case of dry ground fish, purchasers of this "bone" have received the amounts of nitrogen and of phosphoric acid which were guaranteed to them but it was not in the form in which they expected to obtain it. A mixture of ground bone, ammonium sulphate and mineral phosphate is not ground bone, but a mixed fertilizer containing *A mixture of ground bone, ammonium sulphate and mineral phosphate is not ground bone, but a mixed fertilizer containing nitrogen and phosphoric acid.* Moreover, there is a wide difference in price between nitrogen in ammonium sulphate and the organic nitrogen in bone.

8958. This sample was drawn from stock of the Eldredge Hardware Co. and sold by the Berkshire Chemical Co. A small amount of mineral phosphate and of ammonium sulphate was found. Information furnished by the manufacturer was to the effect that this was a small lot of bone mixture in which, however, no mineral phosphate or ammonium sulphate had been used. Samples of the ingredients used were submitted and the presence of these foreign materials in one of them was found, due, no doubt, to accidental contamination in the storage bins.

Analyses are found in Table XI.

TABLE XI. ANALYSES OF GROUND BONE.

Station No.	Manufacturer.	Dealer or Purchaser.	Nitrogen.		Ammonia equivalent to total nitrogen.	Phosphoric Acid.		Mechanical Analysis.		Station No.
			Total found.	Total Guaranteed.		Total Found.	Total Guaranteed.	Finer than 1-50 inch.	Coarser than 1-50 inch.	
	Sampled by Station.		%	%	%	%	%	%	%	
8864	American Agricultural Chemical Co., New York	S. P. Strople, New Britain	2.58	2.06	3.14	24.40	22.88	41.0	59.0	8864
8984	Apothecaries Hall Co., Waterbury	Sampled at factory	4.00	3.29	4.86	23.10	20.00	48.5	51.5	8984
9190	Apothecaries Hall Co., Waterbury	C. A. Templeton, Waterbury	2.61	2.46	3.17	23.65	22.00	62.0	38.0	9190
9000	Armour Fertilizer Works, New York	Silliman Hardware Co., New Canaan	2.40	2.47	2.92	24.60	22.00	64.0	36.0	9000
9404	Berkshire Chemical Co., Bridgeport.	Sampled at factory	2.32	2.47	2.82	24.00	20.00	....	....	9404
9564	E. D. Chittenden Co., Bridgeport	J. E. Stoddard, Abington	2.66	2.47	3.23	24.60	22.00	66.0	34.0	9564
8965	Consolidated Rendering Co., Boston, Mass.	Lightbourn & Pond, New Haven	3.86	2.46	4.69	24.05	22.90	28.0	72.0	8965
9162	Eastern States Farmers' Exchange, Springfield, Mass.	H. H. McKnight, Ellington	2.72	2.46	3.31	25.20	23.00	62.0	38.0	9162
8964	L. T. Frisbie Co., New Haven	Sampled at factory	4.37	3.28	5.31	24.45	22.00	46.0	54.0	8964
8913	Mapes Formula & Peruvian Guano Co., New York	Mapes Branch, Hartford	4.16	3.29	5.06	21.40	20.00	32.0	68.0	8913
8909	Olds & Whipple, Inc., Hartford	Sampled at factory	2.15	2.50	2.61	26.15	22.00	61.5	38.5	8909
9619	Olds & Whipple, Inc., Hartford	Sampled at factory	2.50	2.50	3.04	25.70	22.00	64.5	35.5	9619
9019	The Rogers & Hubbard Co., Portland	Cadwell & Jones, Hartford	3.52	3.29	4.28	20.94	20.50	59.0	41.0	9019
9020	The Rogers & Hubbard Co., Portland	Cadwell & Jones, Hartford	3.60	3.82	4.38	25.70	24.70	73.0	27.0	9020
9503	F. S. Royster Guano Co., Baltimore, Md.	F. B. Newton, Plainville	2.83	2.47	3.44	23.05	22.90	66.0	34.0	9503

TABLE XI. ANALYSES OF GROUND BONE—*Continued.*

Station No.	Manufacturer.	Dealer or Purchaser.	Nitrogen. Total found.	Nitrogen. Total guaranteed.	Ammonia equivalent to total nitrogen.	Phosphoric Acid. Total Found.	Phosphoric Acid. Total guaranteed.	Mechanical Analysis. Finer than 1-50 inch.	Mechanical Analysis. Coarser than 1-50 inch.	Station No.
	Sampled by Station.		%	%	%	%	%	%	%	
9589	M. L. Shoemaker & Co., Philadelphia, Pa.	Geo. T. Soule, New Milford	4.19	3.69	5.09	22.20	22.88	37.0	63.0	9589
9580	I. P. Thomas & Son, Philadelphia, Pa.	Ira W. Beers, Hamden	2.81	2.45	3.42	24.40	23.00	64.0	36.0	9580
8949	U. S. Guano Co., Baltimore, Md.	Frank Libner & Son, Norwalk	2.43	2.47	2.95	18.25	22.00	41.0	59.0	8949
8950	U. S. Guano Co., Baltimore, Md.	H. P. Beers, Southport	2.62	2.47	3.19	21.45	22.00	32.0	68.0	8950
8854	U. S. Guano Co., Baltimore, Md.	Rippe Bros., Westport	2.69	2.47	3.27	22.20	22.00	37.0	63.0	8854
9343	U. S. Guano Co., Baltimore, Md.	E. O. Chapman, North Haven	4.05	3.70	4.92	19.50	22.00	38.0	62.0	9343
9607	U. S. Guano Co., Baltimore, Md.	J. B. Lewis, Southington	3.68	3.30	4.47	20.87	18.30	41.0	59.0	9607
9360	Wilcox Fertilizer Co., Mystic	Jordan Hardware Co., Willimantic	3.11	2.46	3.78	22.17	22.00	46.0	54.0	9360
	Sampled by Purchaser.									
8924	Apothecaries Hall Co., Waterbury	Edwards & Brewer, West Suffield	2.46	2.46	2.99	23.70	22.00	....	....	8924
8456	Apothecaries Hall Co., Waterbury	Hatheway & Steane, Inc., Hartford	3.97	2.46	4.83	22.50	22.00	....	....	8456
8457	Apothecaries Hall Co., Waterbury	Hatheway & Steane, Inc., Hartford	4.20	3.29	5.11	22.59	20.00	38.0	62.0	8457
8652	Apothecaries Hall Co., Waterbury, Car No. 71092	Hatheway & Steane, Inc., Hartford	5.50	3.29	6.69	19.30	20.00	34.0	66.0	8652
8653	Apothecaries Hall Co., Waterbury, Car No. 92570	Hatheway & Steane, Inc., Hartford	3.83	3.29	4.66	23.83	20.00	47.0	53.0	8653

TABLE XI. ANALYSES OF GROUND BONE—*Continued.*

Station No.	Manufacturer.	Dealer or Purchaser.	Nitrogen.		Ammonia equivalent to total nitrogen.	Phosphoric Acid.		Mechanical Analysis.		Station No.
			Total found.	Total guaranteed.		Found.	Guaranteed.	Finer than 1-50 inch.	Coarser than 1-50 inch.	
	Sampled by Purchaser.		%	%	%	%	%	%	%	
8654	Apothecaries Hall Co., Waterbury, Car No. 92666	Hatheway & Steane, Inc., Hartford	4.19	3.29	5.09	23.48	20.00	56.0	44.0	8654
8691	Apothecaries Hall Co., Waterbury, Car No. 10627	Hatheway & Steane, Inc., Hartford	4.74	3.29	5.76	20.40	20.00	43.0	57.0	8691
8819	Apothecaries Hall Co., Waterbury, Car No. 150058	Hatheway & Steane, Inc., Hartford	4.06	3.29	4.94	23.45	20.00	50.0	50.0	8819
8821	Apothecaries Hall Co., Waterbury	Hatheway & Steane, Inc., Hartford	3.55	3.29	4.32	24.60	20.00	62.0	38.0	8821
8836	Apothecaries Hall Co., Waterbury, Car No. 10432	Hatheway & Steane, Inc., Hartford	4.35	3.29	5.29	19.60	20.00	41.0	59.0	8836
8942	Apothecaries Hall Co., Waterbury, Car No. 76685	Hatheway & Steane, Inc., Hartford	3.85	3.29	4.68	23.50	20.00	49.0	51.0	8942
9334	Apothecaries Hall Co., Waterbury	A. N. Shepard & Son, Hartford	2.48	....	3.02	27.95	.....	65.0	35.0	9334
8152	Armour Fertilizer Works, New York, Car No. 49435	American Sumatra Tobacco Co., Bloomfield	2.81	2.47	3.42	23.99	22.00	39.0	61.0	8152
8153	Armour Fertilizer Works, New York, Car No. 50832	American Sumatra Tobacco Co., Bloomfield	2.54	2.47	3.09	24.25	22.00	48.5	51.5	8153
8154	Armour Fertilizer Works, New York, Car No. 60953	American Sumatra Tobacco Co., Bloomfield	2.60	2.47	3.16	23.80	22.00	50.0	50.0	8154
8173	Armour Fertilizer Works, New York, Car No. 81780	American Sumatra Tobacco Co., Bloomfield	2.88	2.47	3.50	23.51	22.00	48.0	52.0	8173

TABLE XI. ANALYSES OF GROUND BONE—*Concluded.*

Station No.	Manufacturer.	Dealer or Purchaser.	Nitrogen.		Ammonia equivalent to total nitrogen.	Phosphoric Acid.		Mechanical Analysis.		Station No.
			Total found.	Total guaranteed.		Total found.	Total guaranteed.	Finer than 1-50 inch.	Coarser than 1-50 inch.	
	Sampled by Purchaser.		%	%	%	%	%	%	%	
8174	Armour Fertilizer Works, New York, Car No. 83734	American Sumatra Tobacco Co., Bloomfield	2.50	2.47	3.04	22.48	22.00	....	....	8174
8253	Armour Fertilizer Works, New York, Car No. 38146	American Sumatra Tobacco Co., Bloomfield	2.62	2.47	3.19	26.46	22.00	51.5	48.5	8253
8260	Armour Fertilizer Works, New York, Car No. 31595	American Sumatra Tobacco Co., Bloomfield	2.42	2.47	2.94	26.69	22.00	42.0	58.0	8260
8261	Armour Fertilizer Works, New York, Car No. 299937	American Sumatra Tobacco Co., Bloomfield	2.60	2.47	3.16	26.51	22.00	36.0	64.0	8261
8290	Armour Fertilizer Works, New York, Car No. 184241	American Sumatra Tobacco Co., Bloomfield	2.74	2.47	3.33	25.82	22.00	37.5	62.5	8290
8291	Armour Fertilizer Works, New York, Car No. 23930	American Sumatra Tobacco Co., Bloomfield	2.76	2.47	3.36	25.84	22.00	43.1	56.9	8291
8304	Armour Fertilizer Works, New York, Car No. 78349	American Sumatra Tobacco Co., Bloomfield	2.98	2.47	3.62	25.70	22.00	39.0	61.0	8304
8333	Armour Fertilizer Works, New York, Car No. 46186	American Sumatra Tobacco Co., Bloomfield	2.85	2.47	3.46	25.54	22.00	31.8	68.2	8333
9112	Consolidated Rendering Co., Boston, Mass	F. H. Smith, Hill Top Farm, Suffield	2.69	2.46	3.27	22.50	22.90	62.0	38.0	9112
8292	Car No. 95779	American Sumatra Tobacco Co., Bloomfield	2.82	....	3.43	24.95	.....	45.8	54.2	8292
9062	U. S. Guano Co., Baltimore, Md...	J. A. Barrasso, Andover	4.77	3.30	5.80	16.80	18.30	43.4	56.6	9062
9303	U. S. Guano Co., Baltimore, Md...	Frank Libner & Sons, Norwalk..	2.30	2.47	2.80	26.53	22.00	19.0	81.0	9303

VI. MIXED FERTILIZERS.

MIXTURES CONTAINING ONLY NITROGEN AND PHOSPHORIC ACID.

Six samples of this group of materials were analyzed.

9195. Ammo-Phos. American Cyanamid Co., New York. Sampled by Station agent from stock of Olds & Whipple, Inc., Hartford, Conn.

9191. Liberty Lawn Fertilizer. Apothecaries Hall Co., Waterbury. Sampled by the Station agent at factory.

9502. Liberty Tobacco Starter. Apothecaries Hall Co., Waterbury. Sampled by the Station agent at factory.

9266. O & W High Grade Tobacco Starter. Olds & Whipple, Inc., Hartford, Conn. Sampled by the Station agent from stock of E. O. Gates, New Hartford, Conn.

9511. "Swift-Sure" Tobacco Starter 4-10-0. M. L. Shoemaker & Co., Philadelphia, Pa. Sampled by the Station agent from stock of Olds & Whipple, Inc., Hartford, Conn.

9118. Diamonphos (for experiment). Synthetic Nitrogen Products Co., New York. Sampled by the Station agent from stock of the Tobacco Station, Windsor, Conn.

	9195	9191	9502	9266	9511	9118[1]
	%	%	%	%	%	%
Nitrogen, found	16.22	4.26	3.80	13.79	3.36	20.66
guaranteed	16.00	3.29	3.29	8.23	3.25	....
Ammonia equivalent to nitrogen	19.72	5.18	4.62	16.77	4.09	25.12
Phosphoric acid, total	19.75	12.68	11.20	2.78	11.98	53.70
available found	19.24	7.60	10.02	2.43	10.73	....
guaranteed	19.00	4.00	10.00	3.00	10.00	....

MIXTURES CONTAINING ONLY PHOSPHORIC ACID AND POTASH.

This group is represented by four samples examined.

9386. Tobacco Ash Elements. American Agricultural Chemical Co. sampled from stock of Spencer Bros., Suffield.

9727. Tobacco Ash Elements. This was a second sample of the above but drawn from another source, stock of Howard Bariesford, West Suffield.

9155. Eastern States Open Formula 0-16-8. Sampled from stock of J. A. Sherwood, Bridgeport.

9514. Dairymen's Special, 0-10-10. I. P. Thomas and Son, Philadelphia, sampled from stock of Hubert Smith, Milford.

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[1] Chlorine none.

	9386	9727	9155	9514
	%	%	%	%
Available phosphoric acid, found	5.30	....	16.23	10.95
guaranteed	5.00	....	16.00	10.00
Potash found	14.00	15.05	8.21	10.95
guaranteed	15.00	15.00	8.00	10.00
Chlorine	1.05	....	....	7.15

Samples **9386** and **9727** require particular comment. These samples gave a great deal of trouble in the determination of potash. In spite of great pains taken to insure a uniform mixture very discordant results were obtained. Exchanges of samples with the manufacturers did not clarify the matter, they too having difficulty in securing satisfactory checks, although their guaranty was based upon factory tests which showed uniformly over 15 per cent according to advices received from them.

The second sample drawn by our agent analyzed slightly over the guaranty but in this case also the accepted figure is an average of several results which are not in as good agreement as could be desired.

MIXED FERTILIZERS CONTAINING NITROGEN, PHOSPHORIC ACID AND POTASH.

In this group of fertilizers 250 official samples have been analyzed in the past season. Analyses of these, and of samples submitted by purchasers, 265 in all, are given in Table XII. The following tabulated statement summarizes the results of the inspection.

Total number of official samples analyzed		250
Samples considerably deficient in		
one item	58	
two items	15	
three items	0	
total samples deficient		73
Total items of plant food guaranteed (250 x 3)		750
Total items found deficient:		
ammonia	27	
available P_2O_5	23	
potash	38	88
Total guaranties substantially met		662
Per cent of guaranties substantially met or exceeded		88
Commercial deficiencies exceeding $1.00 per ton		13

Deficient Samples.

The number of samples which were found considerably deficient in one or more items of plant food is nearly 30 per cent of the total number examined, but the money values of such deficiencies have exceeded $1.00 per ton in only about 5 per cent of the samples. Nearly 90 per cent of the total guaranties made have been substantially met or exceeded.

The distribution of deficiencies and the percentage of guaranties met is shown in the following summary, Table XIII:

TABLE XIII. SUMMARY OF DEFICIENCIES.

Manufacturer.	Number Samples.	Number Guaranties.	Number deficiencies in—			Per cent of guaranties met.
			Ammonia.	Avail P_2O_5.	Potash.	
American Agricultural Chemical Co.	42	126	6	3	4	90
Apothecaries Hall Co.	13	39	1	0	2	92
Armour Fertilizer Works	13	39	2	1	5	80
Atlantic Packing Co.	3	9	0	0	0	100
Bartlett Tree Expert Co.	1	3	0	1	0	67
Berkshire Chemical Co.	9	27	0	0	1	96
A. D. Bridge's Sons, Inc.	2	6	0	0	0	100
E. D. Chittenden Co.	7	21	1	0	2	86
E. B. Clark Seed Co.	5	15	1	0	3	73
C. & R. Sales Co.	1	3	0	0	1	67
Davey Tree Expert Co.	1	3	0	0	0	100
Eastern States Farmers' Exchange	16	48	2	4	4	79
Essex Fertilizer Co.	7	21	2	1	1	81
L. T. Frisbie Co.	7	21	0	0	0	100
Gash-Stull Co.	1	3	1	0	1	33
Grasselli Chemical Co.	1	3	0	0	0	100
International Agricultural Corp.	2	6	1	0	1	67
Lowell Fertilizer Co.	11	33	0	3	0	91
Mapes Formula and Peruvian Guano Co.	14	42	0	1	0	98
A. G. Markham & Co.	3	9	0	0	0	100
New England Fertilizer Co.	7	21	0	0	1	95
Olds & Whipple, Inc.	7	21	0	0	0	100
Parmenter & Polsey Fertilizer Co.	3	9	1	0	1	78
Piedmont-Mt. Airy Guano Co.	2	6	1	0	0	83
Frank S. Platt Co.	2	6	0	0	0	100
Rackliffe Bros. Co., Inc.	2	6	0	0	1	83
The Rogers & Hubbard Co.	16	48	1	2	1	92
F. S. Royster Guano Co.	9	27	0	0	1	96
M. L. Shoemaker & Co.	3	9	0	2	1	67
Springfield Rendering Co.	3	9	0	0	0	100
Swift & Co.	1	3	0	0	0	100
Synthetic Nitrogen Products Co.	1	3	0	0	0	100
I. P. Thomas & Sons	8	24	1	0	3	83
Triton Oil and Fertilizer Co.	4	12	1	0	0	92
U. S. Guano Co.	8	24	2	1	3	75
Virginia-Carolina Chemical Co.	4	12	0	1	1	83
Wilcox Fertilizer Co.	4	12	2	1	0	75
Worcester Rendering Co.	7	21	1	2	0	83

Commercial Deficiencies.

Deficiencies in money value in excess of $1.00 per ton have been shown in thirteen samples this year. This is an approximate value arrived at by balancing shortages against overages and reckoning ammonia at 20 cents, available phosphoric acid at 5½ cents, and potash at 5 cents per pound.

Table XIV. Samples Showing Commercial Deficiencies.

Sta. No.	Brand.	Approximate deficiency in money value per ton.
9200	Bradley's Complete Manure for Potatoes and Vegetables	$1.50[1]
9079	National Aroostook Special Fertilizer	1.64[1]
8997	Armour's Big Crop 8-6-6	1.94[1]
9146	Chittenden's Special Top Dresser	4.96
9592	E. B. Clark Tip Top Brand 5–10-5	1.99
9160	Eastern States 8-16-20	1.25
9622	Eastern States 8-16-20	2.07
9454	Eastern States 10-3-8, Open Formula	1.13
9210	Eastern States 10-16-14, Open Formula	1.99[1]
9565	Essex Top Dressing 7-6-5	1.85
9374	I. A. C. Tobacco Special 7-6-5	1.53
8884	Lowell Corn and Vegetable 4-8-4	1.51[2]
9356	Worcester Rendering Co., Prosperity Brand Complete Dressing	1.63[1]

[1] Second sample not deficient.
[2] Two other samples not deficient.

In a system of inspection where many brands are represented by single analyses the products of the several manufacturers may not be fairly evaluated in any one year. Although it is our purpose to examine at least two samples of any brand showing considerable deficiencies, a second sample is not always obtainable. Comparisons are more informing, therefore, if made upon data covering a period of years. A number of different bases might be chosen for such comparisons, but since it has been our practice for many years to cite brands in which commercial deficiencies amount to one dollar or more per ton, these data have been compiled for the 8-year period 1921-1928, and are tabulated in Table XV. No manufacturer is included unless ten or more samples have been analyzed in the period covered. The compilation shows that of a total of over 1,800 samples analyzed less than 10 per cent have fallen short of guaranties to any considerable extent in commercial value. Or, in other words, purchasers have received commercial values represented by the guaranties in over 90 per cent of purchases made.

TABLE XV. COMMERCIAL DEFICIENCIES FOR THE PERIOD 1921–1928.

Manufacturer.	Total number of samples.	Number equaling or exceeding guaranties in money value.	Per cent for 8 yr. period.	No. of samples for 1928.	Per cent for 1928.
American Agricultural Chemical Co	347	333	96	42	95
Apothecaries Hall Co	74	74	100	13	100
Armour Fertilizer Works	86	67	78	13	92
Atlantic Packing Co	51	47	92	3	100
Berkshire Chemical Co	69	69	100	9	100
Bridge's, A. D. & Sons, Co.	17	17	100	2	100
Chittenden, E. D. Co	52	47	90	7	86
Clark, E. B. Seed Co	37	34	92	5	80
Eastern States Farmers' Exchange	81	66	81	16	75
Essex Fertilizer Co	53	51	96	7	86
Frisbie, L. T. Co	81	71	88	7	100
International Agricultural Corp	61	55	90	2	50
Lowell Fertilizer Co	84	75	89	11	91
Mapes Formula and Peruvian Guano Co	104	103	99	14	100
New England Fertilizer Co.	62	59	95	7	100
Olds and Whipple, Inc	51	51	100	7	100
Parmenter & Polsey Fertilizer Co	28	27	96	3	100
Piedmont-Mt. Airy Guano Co	31	22	71	2	100
Rogers & Hubbard Co., The	113	110	97	16	100
Royster, F. S. Guano Co	63	50	79	9	100
Shoemaker, M. L. & Co	22	22	100	3	100
Springfield Rendering Co	32	30	94	3	100
Thomas, I. P. & Sons	32	32	100	8	100
United States Guano Co	24	23	96	8	100
Virginia-Carolina Chemical Co	57	53	93	4	100
Wilcox Fertilizer Co	60	56	93	4	100
Worcester Rendering Co	32	28	88	7	88
Totals	1804	1672	93	232	95

QUALITY OF THE INSOLUBLE ORGANIC NITROGEN.

In the absence of vegetation tests the character of the nitrogenous material which is insoluble in water is judged by chemical methods. Such methods do not show "availability" of nitrogen but they do distinguish between the better and the poorer sources of water-insoluble nitrogenous material.

Both of the accepted methods for judging the quality of insoluble organic nitrogen depend upon the behavior of such nitrogen when treated with permanganate solutions. When less than 50 per cent of the water-insoluble organic nitrogen is found to be "active" as determined by the alkaline permanganate method, and less than

80 per cent active by the neutral permanganate method, the quality of the insoluble nitrogen is rated as inferior. Both methods are applied before such nitrogen is classed as inferior.

By these methods inferior ammoniates have been indicated in eleven samples; but in some cases the amounts of insoluble organic nitrogen have been so small that they were without practical significance and in others the more active forms of nitrogen practically equalled the guaranties. The samples were, therefore, passed without question.

TABLE XII. ANALYSES OF MIXED FERTILIZERS

Station No.	Manufacturer and Brand.	Grade.	Place of Sampling.
	Sampled by Station: **American Agricultural Chemical Co., New York.**		
9357	A. A. C. Acme Fertilizer	1-9-4	Woodbury
9358	A. A. C. Aroostook Potato Manure	5-8-7	North Haven
9362	A. A. C. Double A Tobacco Fertilizer	5-3-5	Gaylordsville
8865	A. A. C. Gladiator Fertilizer	4-8-7	New Britain
8850	A. A. C. Grass & Lawn Top Dressing	6-6-4	New Britain
8863	A. A. C. Monarch Fertilizer	4-8-4	New Britain
9520	A. A. C. Old Hickory Fertilizer	2-8-10	Rockville
9363	A. A. C. Princess Fertilizer	5-10-5	Gaylordsville
9105	Agrico Fertilizer for Corn	3-10-6	Danbury
9106	Agrico Fertilizer for Potatoes	4-8-6	Bethel
9107	Agrico Fertilizer for Truck	5-10-5	Bethel
9361	Complete General Fertilizer	3-8-4	West Haven
9380	Hi Grade Tobacco	7-3-7	Glastonbury
9082	Bowker's All Round Fertilizer	3-8-4	New Milford
8867	Bowker's Stockbridge Hill & Drill Fertilizer	4-8-7	Bristol
9382	Bowker's Lawn & Garden Dressing	5-8-7	West Haven
9085	Bowker's Market Garden Fertilizer	4-8-4	Collinsville
9081	Bowker's Potato and Vegetable Phosphate	2-9-3	New Milford
9084	Bowker's Stockbridge Early Crop Manure	5-8-7	Collinsville
9086	Bowker's Stockbridge Tobacco Manure	5-3-5	Thompsonville
9381	Bowker's Sure Crop Fertilizer	1-9-4	Willimantic
9111	Bradley's Blood Bone and Potash	5-8-7	Simsbury
9200	Bradley's Complete Manure for Potatoes and Vegetables	4-8-7	East River
9623	Bradley's Complete Manure for Potatoes and Vegetables	4-8-7	West Haven
9196	Bradley's Complete Tobacco Manure	5-3-5	Glastonbury
9076	Bradley's Eclipse Fertilizer	1-9-4	Meriden
9080	Bradley's Northland Potato Grower	4-8-4	Colchester
8978	Bradley's Potato Fertilizer	2-9-3	Meriden
9077	Bradley's Potato Manure	3-8-4	Suffield
8868	Bradley's XL Superphosphate of Lime	3-10-4	Bristol
9079	National Aroostook Special Fertilizer	5-8-7	Middletown
9518	National Aroostook Special Fertilizer	5-8-7	Wallingford
9390	National Complete Tobacco Fertilizer	5-3-5	Simsbury
9078	National Market Garden Fertlizer	3-8-4	Middletown
9512	National Pine Tree State Potato Fertilizer	4-8-4	Middletown
9083	National Premier Potato Manure	4-8-7	Danbury
9087	Sanderson's Atlantic Coast Mixture	3-10-4	West Cheshire
9198	Sanderson's Complete Tobacco Grower	5-3-5	Glastonbury
9593	Sanderson's Formula A	4-8-4	Guilford
9197	Sanderson's Formula B	4-8-7	Glastonbury

CONTAINING NITROGEN, PHOSPHORIC ACID AND POTASH—*Continued.*

Nitrogen.					Phosphoric Acid.			Potash.		
In Nitrates.	In ammonia.	Organic water-soluble.	Organic water-insoluble.	Total.	Citrate-insoluble.	Total.	So-called "Available."	As muriate.	Total.	Station No.
%	%	%	%	%	%	%	%	%	%	%
06	0.31	0.39	0.27	1.[illegible]5	0.68	9.48	8.80	4.14	4.14	9357
04	3.11	0.33	0.43	3.[illegible]5	0.50	8.75	8.25	7.04	7.04	9358
88	1.32	0.04	2.07	4.[illegible]24	0.25	3.18	2.93	0.38	5.29	9362
42	2.00	0.46	0.47	3.[illegible]07	0.55	8.63	8.08	7.18	7.18	8865
54	3.79	0.34	0.52	5.[illegible]31	0.35	6.53	6.18	3.90	3.90	8850
38	2.01	0.49	0.52	3.[illegible]13	0.65	8.65	8.00	4.04	4.04	8863
06	1.02	0.52	0.30	1.[illegible]31	0.60	8.74	8.14	10.17	10.17	9520
50	2.56	0.52	0.52	3.[illegible]98	0.65	10.55	9.90	5.25	5.25	9363
30	1.33	0.49	0.44	2.[illegible]11	0.70	10.85	10.15	5.93	5.93	9105
44	1.68	0.66	0.52	4.01	0.70	8.78	8.08	5.71	5.71	9106
38	2.63	0.61	0.50	5.01	0.68	10.68	10.00	5.19	5.19	9107
02	1.60	0.45	0.63	3.28	0.75	8.79	8.04	3.95	3.95	9361
65	1.29	0.21	3.69	7.10	0.96	4.38	3.42	0.16	8.01	9380
08	1.58	0.31	0.30	2.76	0.55	8.90	8.35	3.92	3.92	9082
40	1.94	0.42	0.41	3.85	0.53	8.90	8.37	6.78	6.78	8867
58	2.92	0.07	0.54	5.00	0.68	9.00	8.32	6.31	7.15	9382
38	2.00	0.47	0.44	4.00	0.68	8.68	8.00	3.98	3.98	9085
08	0.95	0.47	0.29	2.18	0.78	9.43	8.65	3.03	3.03	9081
42	2.69	0.61	0.46	5.08	0.53	8.58	8.05	6.85	6.85	9084
74	1.22	0.02	2.18	5.06	0.38	4.20	3.82	1.73	5.11	9086
00	0.29	0.46	0.24	1.20	0.68	9.80	9.12	4.58	4.58	9381
97	2.16	0.41	0.[illegible]6	4.94	0.60	8.78	8.18	7.04	7.04	9111
21	1.77	0.42	0.[illegible]5	3.46	0.30	7.85	7.55	8.16	8.16	9200
31	2.03	0.53	0.[illegible]33	4.05	0.38	8.95	8.57	7.40	7.40	9623
94	0.91	1.03	2.[illegible]86	5.91	0.27	4.00	3.73	0.36	6.73	9196
33	0.28	0.41	0.[illegible]00	1.22	0.60	9.48	8.88	4.52	4.52	9076
56	1.99	0.47	0.[illegible]33	4.05	0.75	8.73	7.98	3.86	3.86	9080
77	0.86	0.43	0.[illegible]78	2.16	0.80	9.43	8.63	2.94	2.94	8978
20	1.64	0.40	0.[illegible]42	2.94	0.75	8.85	8.10	4.06	4.06	907[illegible]
52	1.46	0.24	0.[illegible]51	3.05	0.90	10.70	9.80	4.06	4.06	88[illegible]
21	2.40	0.53	3.82	4.64	0.43	8.45	8.02	6.78	6.78	9[illegible]
22	2.52	0.56	3.94	4.79	0.48	8.43	7.95	7.26	7.26	
33	1.16	0.10	4.22	5.13	0.30	3.55	3.25	0.09	4.57	
55	1.60	0.51	2.56	3.11	0.65	8.93	8.28	4.01	4.01	
51	2.04	0.59	3.29	4.00	0.50	8.53	8.03	3.95	3.9[illegible]	
33	1.98	0.51	3.30	4.01	0.50	8.98	8.48	7.07	7[illegible]	
55	1.63	0.41	2.44	2.97	0.73	11.11	10.38	4.24		
99	1.22	0.40	4.50	5.47	0.30	3.35	3.05	0.39		
55	1.97	0.53	3.32	4.04	0.65	8.75	8.10	4.00		
77	1.11	0.26	3.44	4.18	0.09	8.43	8.34	0.7[illegible]		

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TABLE XII. ANALYS

Station No.	Manufacturer and Brand.	Grade.	Place of Sampling.
		2-9-3	Clintonville
		3-8-4	Derby
	Sampled by Station:		
	American Agricultural Chemical New York.		
9384	Sanderson's Corn Superhphosphate	2-8-2	Greenville
9383	Sanderson's Potato Manure	2-12-4	Greenville
		3-8-3	Waterbury
	Apothecaries Hall Co., Waterbury, Conn.	5-8-7	West Cheshire
		7-3-7	East Windsor
9102	Liberty Corn and All Crops	4-2-5	Waterbury
9103	Liberty Corn, Fruit and All Crops 2-12		
9110	Liberty Fish, Bone and Potash 3-8-3	4-8-7	East Windsor
9101	Liberty H. G. Market Gardeners 5-8-7	4-8-10	East Windsor
9387	Liberty H. G. Tobacco Manure 7-3-7		
9385	Liberty Home Vegetable Garden Fertiliz	4-8-4	Cheshire
9100	Liberty Onion Special (Potash as Sulp 4-8-7	2-8-10	Waterbury
9193	Liberty Potato and General Crop 4-8-10	3½-8	New London
9541	Liberty Potato and Market Garden Sp 4-8-4	7-8-6	Waterbury
		5-3-5	New Milford
9109	Liberty Potato and Vegetable 2-8-10		
9104	Liberty Top Dresser for Grass and Grain ½-8		
9108	Liberty Special Fertilizer for Fruit 7-8-6	2-4	Wethersfield
9551	Liberty Tobacco Special 5-3-5	8-4	Danbury
		10	Granby
	Armour Fertilizer Works, New York.	3-4	Plainville
		-7	So. Glastonbury
9443	Armour's Big Crop Fertilizer 2-12-4	-4	So. Meriden
9002	Armour's Big Crop Fertilizer 3-8-4	-5	Thompsonville
9446	Armour's Big Crop Fertilizer 4-6-10	7	Milford
8888	Armour's Big Crop 4-8-4	0	Wethersfield
9442	Armour's Big Crop Fertilizer 4-8-7	7	Wallingford
9389	Armour's Big Crop Fertilizer 4-16-4	6	Madison
9448	Armour's Big Crop Tobacco Special 5-3-5	5	Seymour
9137	Armour's Big Crop Fertilizer 5-8-7		Granby
44	Armour's Big Crop Fertilizer 7-11-10		
3	Armour's Big Crop 7-12-7		
	Armour's Big Crop 8-6-6		
	Armour's Big Crop 8-6-6		So. Windsor
	rmour's Big Crop Tobacco Fertilizer		Silver Lane
	Atlantic Packing Co., New Haven, Conn.		
	ic 5-8-7		
	5-4-16	5	

CONTAINING NITROGEN, RIC ACID AND POTASH—*Continued.*

Nitrogen.					Phosphoric Acid.			Potash.		
In Nitrates.	In Ammonia.	Organic water-soluble.	Organic water-insoluble.	% to total nitro...	Citrate-insoluble.	Total.	So-called "Available".	As muriate.	Total.	Station No.
%	%	%	%	%	%	%	%	%	%	%
08	0.90	0.50	0.43							
08	1.48	0.40	0.51	**2.32**	0.80	9.88	**9.08**	3.17	**3.17**	9384
				3.00	0.95	9.23	**8.28**	3.98	**3.98**	9383
02	1.28	0.22	0.54							
05	1.75	0.28	0.16	**2.50**	1.10	9.00	**7.90**	2.64	**2.64**	9102
05	1.33	0.30	1.40	**2.72**	1.20	12.40	**11.20**	5.61	**5.61**	9103
22	3.58	0.26	0.34	**3.74**	1.05	9.05	**8.00**	3.73	**3.73**	9110
00	2.43	0.54	2.88	**5.35**	0.80	8.70	**7.90**	7.22	**7.22**	9101
17	0.07	0.72	2.94	**7.11**	0.66	6.33	**5.67**	0.20	**7.77**	9387
				4.74	5.68	10.50	**4.82**	6.05	**6.05**	9385
34	2.00	0.57	0.88							
11	2.02	0.19	0.13	**4.61**	3.65	14.68	**11.03**	0.61	**5.86**	9100
			5	**4.19**	0.85	8.90	**8.05**	10.03	**10.03**	9193
04	2.10	0.44	0.9							
73	1.21	0.24	0.32	**4.28**	0.85	9.30	**8.45**	4.49	**4.49**	9541
			52	**3.06**	0.58	9.18	**8.60**	8.64	**8.64**	9109
22	5.50	0.10	0.							
01	3.91	0.56	0.90	**9.60**	0.28	4.28	**4.00**	8.53	**8.53**	9104
10	1.50	0.26	2.84	**7.10**	1.88	10.73	**8.85**	6.52	**6.52**	9108
			.20	**5.11**	0.36	5.50	**5.14**	0.77	**6.27**	9551
32	1.50	0.05	0							
21	2.55	0.01	1.99	**2.42**	0.58	12.00	**11.42**	5.09	**5.09**	9143
07	2.26	0.83	2.95	**3.59**	0.73	8.73	**8.00**	4.58	**4.58**	9002
81	2.54	0.00	3.24	**3.94**	0.50	6.70	**6.20**	10.56	**10.56**	9446
57	2.41	0.12	3.50	**4.26**	0.60	8.65	**8.05**	3.81	**3.81**	8888
45	2.91	0.04	3.25	**3.95**	0.58	8.85	**8.27**	6.76	**6.76**	9442
33	0.13	0.30	3.50	**4.26**	0.58	17.00	**16.42**	3.84	**4.17**	9389
70	2.91	0.15	4.08	**4.96**	0.18	3.65	**3.47**	0.21	**4.84**	9448
09	4.55	0.13	3.97	**4.83**	0.40	8.63	**8.23**	6.77	**6.77**	91
99	4.48	0.26	5.87	**7.14**	0.80	12.02	**11.22**	9.65	**9.65**	9
21	4.61	0.33	5.84	**7.10**	0.35	12.48	**12.13**	6.02	**6.92**	
14	5.00	0.38	6.21	**7.55**	1.13	7.55	**6.42**	5.40	**5.40**	
88	0.18	0.0	6.56	**7.98**	1.00	7.04	**6.04**	5.84	**5.84**	
			5	5.77	**7.02**	0.20	3.33	**3.13**	0.07	**5.9**
65	0.07	0.5								
82	1.06	0.8	07	4.23	**5.14**	1.29	9.40	**8.11**	0.36	
			06	4.78	**5.81**	0.55	7.15	**6.60**	0.3	

TABLE XII. ANALYSES ED FERTILIZERS

Station No.	Manufacturer and Brand.	Grade.	Place of Sampling.
	Sampled by Station:		
	Atlantic Packing Co., New Haven, Conn.		
9437	Atlantic Special Vegetable 4-8-4	4-8-4	Waterbury
	F. A. Bartlett Tree Expert Co., Stamford, Conn.		
9136	Bartlett's Green Tree Food	6-8-4	Stamford
	Berkshire Chemical Co., Bridgeport, Conn.		
9440	Berkshire Complete Tobacco		
9444	Berkshire Economical Grass Fertilizer	5-3-5	Suffield
9138	Berkshire Grass Special	0-3-8	Broad Brook
9003	Berkshire Long Island Special	7-6-5	Waterbury
9139	Berkshire Market Garden Fertilizer	5-8-7	Brookfield
9001	Berkshire Potato and Vegetable Fertilizer	1-8-4	Torrington
9376	Berkshire Tobacco Special	-9-3	New Canaan
9142	Berkshire Tobacco Starter	-3-7	Hockanum
9141	Berkshire Truck Fertilizer	3-10	Ellington
		8-5	Ellington
	Amos D. Bridges' Sons, Inc., Hazardville, Conn.		
9140	Corn, Onion, Potato and General Purpose Fertilizer		
9461	Special Tobacco Fertilizer	-4	Hazardville
		-5	Hazardville
	E. D. Chittenden Co., Bridgeport, Conn.		
9211	Chittenden's Complete Grain		
9189	Chittenden's High Grade Potato	3	Bloomfield
9192	Chittenden's Potato Special 4% Potash		Tolland
505	Chittenden's Tobacco Special		Bloomfield
16	Chittenden's Special Top Dresser		Wapping
	Chittenden's Valley Wrapper Brand		Tolland
	Chittenden's Vegetable and Onion Grower		Addison
			Tolland
	E. B. Clark Seed Co., Milford, Conn.		
	ial Mixture for General Use	4	Branford
	l Mixture with 6% Potash	4	ranford
	Phosphate	5	ranford

OSPHORIC

TAINING NITROGEN, PHOSPHORIC ACID AND POTASH—*Continued.*

Nitrogen.					Phosphoric Acid.			Potash.		
In ammonia.	Organic water-soluble.	Organic water-insoluble.	Total.	Ammonia equivalent to total nitrogen.	Citrate-insoluble.	Total.	So-called "Available".	As muriate.	Total.	Station No.
%	%	%	%	%	%	%	%	%	%	%
1.2										
4.7	2.12	0.44	0.53	3.50	**4.26**	1.32	9.45	**8.13**	3.97	**3.97**	**9437**
5.9										
4.										
6.										
4	4.10	0.18	1.19	5.47	**6.65**	3.36	10.96	**7.60**	4.33	**4.33**	**9136**
2										
4										
3										
	0.07	0.46	2.86	4.48	**5.45**	0.56	3.63	**3.07**	0.52	**5.68**	**9440**
	0.04	0.60	0.80	8.42	**10.24**	3.90	9.68	**5.78**	2.07	**8.37**	**9444**
	1.42	1.97	0.70	6.28	**7.64**	1.49	7.55	**6.06**	6.59	**6.59**	**9138**
	2.51	0.29	0.76	4.43	**5.39**	0.45	8.78	**8.33**	7.60	**7.60**	**9003**
	1.94	0.18	0.83	3.50	**4.26**	0.18	8.87	**8.69**	4.55	**4.55**	**9139**
	1.54	0.17	0.14	1.91	**2.32**	0.53	10.23	**9.70**	4.79	**4.79**	**9001**
	0.10	0.51	3.30	6.11	**7.43**	0.15	3.80	**3.65**	0.70	**6.88**	**9376**
	2.37	0.22	0.63	4.78	**5.81**	0.93	10.25	**9.32**	0.82	**8.77**	**9142**
	3.12	0.32	1.00	4.53	**5.51**	0.45	8.70	**8.25**	5.94	**5.94**	**9141**
	1.75	0.12	0.80	3.47	**4.22**	0.68	9.38	**8.70**	4.28	**4.28**	**9140**
	0.07	0.44	2.96	4.66	**5.67**	0.45	4.60	**4.15**	0.09	**5.45**	**9461**
	1.44	0.13	0.29	1.93	**2.35**	0.53	10.05	**9.52**	2.74	**2.74**	**9211**
	3.64	0.12	0.30	4.14	**5.03**	0.18	8.40	**8.22**	7.09	**7.09**	**9199**
	2.68	0.23	0.35	3.26	**3.96**	0.53	8.66	**8.13**	4.02	**4.02**	**9192**
	2.48	0.28	1.64	4.40	**5.35**	0.20	5.20	**5.00**	1.06	**5.75**	**9505**
	4.47	0.53	0.32	5.32	**6.47**	0.23	7.88	**7.65**	5.34	**5.34**	**9146**
	2.19	0.22	2.65	5.06	**6.15**	0.56	4.96	**4.40**	0.32	**5.19**	**9459**
	2.29	0.23	0.30	2.89	**3.51**	0.23	8.88	**8.65**	3.69	**4.19**	**9214**
	2.27	0.44	0.73	3.44	**4.18**	0.55	8.65	**8.10**	4.44	**4.44**	**9205**
	2.38	0.37	0.80	3.60	**4.38**	0.61	9.08	**8.47**	6.45	**6.45**	**9207**
	3.46	0.18	0.44	4.22	**5.13**	0.45	8.68	**8.23**	6.31	**6.31**	**9206**

TABLE XII. ANALYSES OF MIXED FERTILIZERS

Station No.	Manufacturer and Brand.	Grade.	Place of Sampling.
	Sampled by Station:		
	E. B. Clark Seed Co., Milford, Conn.		
9725	Super Phosphate	5-8-7	Milford
9592	Tip Top Brand	5-10-5	Milford
	C. &. R. Sales Co., Worcester, Mass.		
9562	C. & R. Lawn and Shrub Fertilizer	5-6-5	Norwich
	Davey Tree Expert Co., Kent, Ohio		
8998	Davey Tree Food	7-8-3	Sound Beach
	Eastern States Farmers' Exchange, Springfield, Mass.		
9457	Buckland's Formula A 6-2-7 Special Tobacco Mixture	6-2-7	So. Manchester
9209	Eastern States 3-12-3 Open Formula	3-12-3	Bridgeport
9208	Eastern States 4-8-10 Open Formula	4-8-10	Bridgeport
9151	Eastern States 4-16-4 Open Formula	4-16-4	North Haven
9153	Eastern States 5-8-7 Open Formula	5-8-7	North Haven
9158	Eastern States 5-10-5 Open Formula	5-10-5	Ellington
9156	Eastern States 8-6-6 Open Formula	8-6-6	Bridgeport
9213	Eastern States 8-16-8 Open Formula	8-16-8	Ellington
9160	Eastern States 8-16-20 Open Formula	8-16-20	Ellington
9622	Eastern States 8-16-20 Open Formula	8-16-20	West Simsbury
9455	Eastern States Open Formula 9-3-7 Tobacco Fertilizer	9-3-7	Granby
9454	Eastern States Open Formula 10-3-8 Tobacco Fertilizer	10-3-8	Ellington
9737	Eastern States 10-16-14 (Potash from Sulphate) Open Formula	10-16-14	Granby
9004	Eastern States 10-16-14 Open Formula	10-16-14	Ellington
9210	Eastern States 10-16-14 Open Formula	10-16-14	Bethel
9608	Eastern States 10-16-14 Open Formula	10-16-14	Branford
	Essex Fertilizer Co., Boston, Mass.		
9450	Essex A1 Super 2-10-2	2-10-2	Wallingford
9224	Essex Complete Manure 5-8-7	5-8-7	Wallingford
9204	Essex Fish Fertilizer for All Crops 3-8-4	3-8-4	Wallingford
9203	Essex Market Garden 4-8-4	4-8-4	Wallingford
9453	Essex Peerless Potato Manure 4-6-10	4-6-10	Warehouse Point
9567	Essex Tobacco Manure 5-3-5	5-3-5	New Milford
9565	Essex Top Dressing 7-6-5	7-6-5	So. Manchester

CONTAINING NITROGEN, PHOSPHORIC ACID AND POTASH—*Continued.*

Nitrogen.					Ammonia equivalent to total nitrogen.	Phosphoric Acid.			Potash.		Station No.
In Nitrates.	In ammonia.	Organic water-soluble.	Organic water-insoluble.	Total.		Citrate-insoluble.	Total.	So-called "Available".	As muriate.	Total.	
%	%	%	%	%	%	%	%	%	%	%	%
....	....	....	....	4.05	**4.92**	0.75	9.35	**8.60**	....	**6.47**	**9725**
.19	2.70	0.39	0.44	3.72	**4.52**	0.43	10.78	**10.35**	4.54	**4.54**	**9592**
.25	2.18	1.49	2.28	6.20	**7.54**	0.95	7.35	**6.40**	4.47	**4.47**	**9562**
.00	3.50	0.54	2.02	6.06	**7.37**	5.15	13.68	**8.53**	3.21	**3.21**	**8998**
.22	0.88	0.92	3.76	5.78	**7.03**	0.38	4.84	**4.46**	0.68	**8.00**	**9457**
.73	1.25	0.32	0.30	2.60	**3.16**	0.45	12.18	**11.73**	3.24	**3.24**	**9209**
.16	2.23	0.64	0.29	3.32	**4.04**	0.39	8.68	**8.29**	10.05	**10.05**	**9208**
.89	1.98	0.30	0.38	3.55	**4.32**	0.48	15.00	**14.52**	5.90	**5.90**	**9151**
..00	2.70	0.53	0.24	4.47	**5.43**	0.53	8.83	**8.30**	7.03	**7.03**	**9153**
.64	2.52	0.82	0.35	4.33	**5.26**	0.18	11.00	**10.82**	5.44	**5.44**	**9158**
.18	3.68	0.66	0.23	6.75	**8.21**	0.23	6.60	**6.37**	6.47	**6.47**	**9156**
..26	4.67	0.73	0.34	7.00	**8.51**	0.38	16.05	**15.67**	11.91	**11.91**	**9213**
..16	4.58	0.48	0.50	6.72	**8.17**	0.55	17.20	**16.65**	17.35	**17.35**	**9160**
..32	4.22	0.12	0.86	6.52	**7.93**	0.68	16.05	**15.37**	18.90	**18.90**	**9622**
.50	0.60	1.34	3.61	8.05	**9.79**	0.08	4.85	**4.77**	0.74	**9.36**	**9455**
.08	0.85	1.44	2.88	7.25	**8.81**	0.50	6.25	**5.75**	1.83	**8.61**	**9454**
..66	5.92	0.26	0.94	8.78	**10.67**	0.30	16.55	**16.25**	1.38	**14.00**	**9737**
..64	5.44	0.26	0.80	8.14	**9.90**	0.58	17.38	**16.80**	14.38	**14.38**	**9004**
..00	5.51	1.02	0.42	7.95	**9.67**	0.63	17.20	**16.57**	12.70	**12.70**	**9210**
..36	5.85	0.65	0.44	8.30	**10.09**	0.85	18.65	**17.80**	13.21	**13.21**	**9608**
.00	0.92	0.43	0.30	1.65	**2.01**	0.65	11.43	**10.78**	1.92	**1.92**	**9450**
.18	2.97	0.66	0.52	4.33	**5.26**	1.20	9.53	**8.33**	7.36	**7.36**	**9224**
.03	1.36	0.52	0.58	2.49	**3.03**	0.75	8.35	**7.60**	4.13	**4.13**	**9204**
.31	1.80	0.47	0.74	3.32	**4.04**	0.88	11.10	**10.22**	4.41	**4.41**	**9203**
.35	1.70	0.57	0.55	3.17	**3.85**	0.58	6.60	**6.02**	9.93	**9.93**	**9452**
..65	0.14	0.41	2.30	4.50	**5.47**	0.50	4.57	**4.07**	0.61	**5.29**	**9567**
.00	5.08	0.29	0.09	5.46	**6.64**	0.33	6.35	**6.02**	4.57	**4.57**	**9565**

TABLE XII. ANALYSES OF MIXED FERTILIZERS

Station No.	Manufacturer and Brand.	Grade.	Place of Sampling.
	Sampled by Station:		
	L. T. Frisbie Co., New Haven, Conn.		
9225	Frisbie's 5-8-7	5-8-7	Wethersfield
9227	Frisbie's Corn and Grain Fertilizer 2-10-2	2-10-2	Danbury
9229	Frisbie's Market Garden	4-8-7	North Woodbury
9223	Frisbie's Special 3-8-4	3-8-4	New Haven
9226	Frisbie's Special Vegetable and Potato Grower 4-8-4	4-8-4	Danbury
9460	Frisbie's Tobacco Grower 5-3-5	5-3-5	So. Windsor
9230	Frisbie's Top Dresser 7-6-5	7-6-5	Watertown
	Gash-Stull Co., Chester, Pa.		
9488	Young's Formula 8-7-6	8-7-6	Mfg.'s sample
	Grasseli Chemical Co., Cleveland, Ohio		
9234	Grasselli Odorless Plant Food	5-13-4	Fair Haven
	International Agricultural Corp., Boston, Mass.		
9374	I. A. C. Tobacco Special 7-6-5	7-6-5	Hockanum
9375	Vuelta Abajo Special Tobacco Formula	7-9-8	Hockanum
	Lowell Fertilizer Co., Boston, Mass.		
8871	Lowell Animal Brand for All Crops 3-8-4	3-8-4	Southington
9563	Lowell Bone Fertilizer 2-10-2	2-10-2	Moosup
8873	Lowell Corn and Vegetable 4-8-4	4-8-4	Southington
8884	Lowell Corn and Vegetable 4-8-4	4-8-4	Cheshire
9521	Lowell Corn and Vegetable 4-8-4	4-8-4	Cheshire
8885	Lowell Market Garden Manure 5-8-7	5-8-7	Cheshire
8872	Lowell Market Garden Manure 5-8-7	5-8-7	Southington
9228	Lowell Potato Grower 4-6-10	4-6-10	Southbury
9243	Lowell Tobacco Manure 5-3-5	5-3-5	Ellington
9244	Lowell Top Dressing 7-6-5	7-6-5	Ellington
9245	Lowell 5-10-5	5-10-5	New Haven
	Mapes Formula and Peruvian Guano Co., New York.		
9247	Mapes Conn. Valley Special	6-4-7	East Granby
8972	The Mapes Corn Manure	3-8-3	Hartford
9027	The Mapes General Truck Manure	5-6-5	Hartford
9246	The Mapes General Tobacco Manure	5-4-5	East Granby

CONTAINING NITROGEN, PHOSPHORIC ACID AND POTASH—*Continued.*

Nitrogen.					Ammonia equivalent to total nitrogen.	Phosphoric Acid.			Potash.		Station No.
In Nitrates.	In Ammonia	Organic water-soluble.	Organic water-insoluble.	Total.		Citrate-insoluble.	Total.	So-called "Available".	As muriate.	Total.	
%	%	%	%	%	%	%	%	%	%	%	%
027	2.90	0.51	0.64	4.32	**5.25**	0.93	9.53	**8.60**	7.25	**7.25**	**9225**
004	0.78	0.51	0.58	1.91	**2.32**	1.08	11.33	**10.25**	2.26	**2.26**	**9227**
040	1.92	0.50	0.77	3.59	**4.36**	1.15	9.23	**8.08**	6.90	**6.90**	**9229**
001	1.52	0.51	0.69	2.73	**3.32**	1.03	9.20	**8.17**	4.27	**4.27**	**9223**
029	2.22	0.55	0.64	3.70	**4.50**	1.05	9.45	**8.40**	4.12	**4.12**	**9226**
141	0.13	0.43	2.74	4.71	**5.73**	0.57	4.30	**3.73**	0.16	**5.11**	**9460**
104	3.52	0.68	0.66	5.90	**7.17**	0.65	7.20	**6.55**	5.19	**5.19**	**9230**
216	3.18	0.48	0.50	6.32	**7.68**	0.58	8.15	**7.57**	5.73	**5.73**	**9488**
000	4.24	0.00	0.11	4.35	**5.29**	1.08	16.90	**15.82**	4.42	**4.42**	**9234**
1 3	2.01	0.11	1.97	5.52	**6.71**	0.28	6.40	**6.12**	0.54	**4.50**	**9374**
052	1.76	0.83	2.29	5.70	**6.93**	0.53	9.43	**8.90**	0.72	**8.21**	**9375**
000	1.41	0.61	0.38	2.40	**2.92**	0.93	8.68	**7.75**	1.78	**3.98**	**8871**
000	1.04	0.51	0.30	1.85	**2.25**	1.20	10.48	**9.28**	2.15	**2.15**	**9563**
009	1.76	0.50	0.55	3.20	**3.89**	0.85	8.85	**8.00**	3.94	**3.94**	**8873**
006	1.87	0.40	0.60	3.23	**3.93**	1.13	8.08	**6.95**	3.93	**3.93**	**8884**
001	2.10	0.49	0.70	3.60	**4.38**	1.08	8.40	**7.32**	4.43	**4.43**	**9521**
008	2.55	0.50	0.67	4.10	**4.98**	0.65	9.03	**8.38**	7.11	**7.11**	**8885**
005	2.74	0.53	0.52	4.14	**5.03**	0.70	8.75	**8.05**	6.82	**6.82**	**8872**
004	1.86	0.52	0.64	3.36	**4.09**	0.60	6.85	**6.25**	10.48	**10.48**	**9228**
109	0.11	0.35	2.44	4.59	**5.58**	0.63	4.85	**4.22**	0.61	**5.46**	**9243**
109	3.49	0.65	0.65	5.88	**7.15**	0.78	7.03	**6.25**	5.13	**5.13**	**9244**
1.0	1.16	0.58	0.70	4.24	**5.15**	1.13	11.15	**10.02**	5.40	**5.40**	**9245**
2.6	0.00	0.20	2.83	5.09	**6.19**	1.28	6.03	**4.75**	0.54	**7.67**	**9247**
000	1.84	0.00	0.50	2.44	**2.97**	1.18	10.40	**9.22**	3.46	**3.69**	**8972**
.0	3.50	0.23	0.58	4.31	**5.24**	1.18	8.78	**7.60**	5.48	**5.48**	**9027**
.8	0.04	0.16	2.80	4.48	**5.45**	1.35	5.40	**4.05**	0.36	**5.34**	**9246**

TABLE XII. ANALYSES OF MIXED FERTILIZERS

Station No.	Manufacturer and Brand.	Grade.	Place of Sampling.
	Sampled by Station: **Mapes Formula and Peruvian Guano Co., New York**		
8966	The Mapes General Use Manure	3-6-4	Windsor Locks.
9241	The Mapes Onion Manure	4-6-4	Hartford
8967	The Mapes Potato Manure	4-7-5	Windsor Locks.
9240	The Mapes Special Trucker "S.P."	5-8-7	Hartford
9242	The Mapes Special Trucker	5-8-7	Bloomfield
9248	The Mapes Tobacco Ash Constituents	1-4-15	East Granby
9486	The Mapes Tobacco Ash and Starter	4-6-15	East Granby
9251	The Mapes Tobacco Manure Wrapper Brand.	7.5-2-10.5	East Granby
9026	The Mapes Tobacco Starter Improved	5-6-1	Windsor Locks.
8968	The Mapes Top Dresser	10-4-2	Windsor Locks.
	A. G. Markham & Co., Springfield, Mass.		
9249	4-8-4	4-8-4	Mansfield Depot
9250	4-6-10	4-6-10	Mansfield Depot
9490	5-8-7	5-8-7	Stafford Springs
	New England Fertilizer Co., Boston, Mass.		
9260	New England Complete Manure 4-6-10	4-6-10	Meriden
8971	New England Corn Phosphate 2-10-2	2-10-2	Rockville
8970	New England Market Garden Manure 5-8-7	5-8-7	Rockville
9259	New England Potato and Vegetable Manure 4-8-4	4-8-4	Meriden
8969	New England Super, A High Grade Fertilizer for all Crops	3-8-4	Rockville
9265	New England Tobacco Manure 5-3-5	5-3-5	Warehouse Poin
9599	New England Tobacco Manure 7-3-7	7-3-7	Glastonbury
	Olds & Whipple, Inc., Hartford, Conn.		
9483	O & W Blue Label Tobacco Fertilizer	6-3-6	Hockanum
9023	O & W Complete Market Garden	4-8-4	So. Manchester.
9489	O & W Complete Tobacco Fertilizer	5-3-5	Hockanum
9591	O & W Grain and General Crop Fertilizer	2-9-3	So. Manchester.
9024	O & W Grass Fertilizer	6-6-4	So. Manchester.
9484	O & W H. G. Starter and Potash	5-4-15	Burnside
9025	O & W High Grade Vegetable and Potato Fertilizer	5-8-7	So. Manchester.

CONTAINING NITROGEN, PHOSPHORIC ACID AND POTASH—*Continued.*

Nitrogen.					Ammonia equivalent to total nitrogen.	Phosphoric Acid.			Potash.		Station No.
In Nitrates.	In ammonia.	Organic water-soluble.	Organic water-insoluble.	Total.		Citrate-insoluble.	Total.	So-called "Available".	As muriate.	Total.	
%	%	%	%	%	%	%	%	%	%	%	%
00	2.40	0.11	0.53	3.04	**3.70**	0.83	7.38	**6.55**	4.91	**4.91**	**8966**
54	2.40	0.18	0.37	3.49	**4.24**	0.75	8.70	**7.95**	0.11	**4.48**	**9241**
00	3.00	0.00	0.43	3.43	**4.17**	0.93	9.18	**8.25**	4.91	**4.91**	**8967**
00	3.36	0.21	0.54	4.11	**5.00**	1.03	11.30	**10.27**	0.51	**7.38**	**9240**
00	3.07	0.17	0.53	3.77	**4.58**	1.20	10.30	**9.10**	6.93	**6.93**	**9242**
01	0.07	0.18	0.93	1.19	**1.45**	1.38	6.45	**5.07**	0.56	**15.67**	**9248**
10	0.00	0.51	0.32	3.93	**4.78**	1.70	7.33	**5.63**	0.86	**15.12**	**9486**
97	0.16	0.48	3.15	6.76	**8.22**	1.40	5.20	**3.80**	0.98	**11.51**	**9251**
51	1.70	0.29	1.02	4.52	**5.50**	3.28	10.03	**6.75**	1.61	**1.61**	**9026**
43	5.89	0.19	0.34	8.85	**10.76**	0.40	6.13	**5.73**	1.55	**2.42**	**8968**
43	1.87	0.49	0.65	3.44	**4.18**	0.85	9.00	**8.15**	4.24	**4.24**	**9249**
43	1.89	0.67	0.63	3.62	**4.40**	0.65	6.78	**6.13**	10.39	**10.39**	**9250**
71	2.13	0.74	0.62	4.20	**5.11**	1.13	9.30	**8.17**	7.30	**7.30**	**9490**
26	1.86	0.58	0.64	3.34	**4.06**	0.58	6.63	**6.05**	10.45	**10.45**	**9260**
01	1.40	0.33	0.36	2.10	**2.55**	1.40	11.55	**10.15**	2.25	**2.25**	**8971**
44	2.50	0.60	0.66	4.20	**5.11**	0.30	8.88	**8.58**	6.90	**6.90**	**8970**
34	1.90	0.50	0.60	3.34	**4.06**	0.93	9.85	**8.92**	4.35	**4.35**	**9259**
04	1.50	0.36	0.58	2.48	**3.02**	1.00	9.05	**8.05**	3.78	**3.78**	**8969**
37	0.14	0.23	2.60	4.34	**5.28**	0.45	4.10	**3.65**	0.41	**5.17**	**9265**
59	0.51	0.40	3.28	5.78	**7.03**	0.33	4.55	**4.22**	0.20	**7.64**	**9599**
12	0.06	0.46	3.42	5.06	**6.15**	0.25	4.43	**4.18**	0.49	**6.38**	**9483**
64	1.76	0.35	0.73	3.48	**4.23**	1.08	9.40	**8.32**	4.16	**4.16**	**9023**
11	0.07	0.51	2.75	4.44	**5.40**	0.25	4.05	**3.80**	0.54	**5.52**	**9489**
54	0.90	0.03	0.53	2.00	**2.43**	0.88	10.53	**9.65**	3.33	**3.33**	**9591**
18	2.50	0.33	0.18	5.19	**6.31**	0.75	7.35	**6.60**	4.00	**4.00**	**9024**
76	0.88	0.40	2.04	4.08	**4.96**	0.45	5.13	**4.68**	0.98	**16.36**	**9498**
09	2.72	0.16	0.53	4.50	**5.47**	0.65	8.93	**8.28**	8.76	**8.76**	**9025**

TABLE XII. ANALYSES OF MIXED FERTILIZERS

Station No.	Manufacturer and Brand.	Grade.	Place of Sampling.
	Sampled by Station:		
	Parmenter & Polsey Fertilizer Co., Boston, Mass.		
9481	P & P Top Dressing	7-6-5	Wallingford
9487	P & P "AA" Brand 5-8-7	5-8-7	Plainville
9261	P & P Maine Potato Fertilizer 4-6-10	4-6-10	Wallingford
	Piedmont Mt. Airy Guano Co., Baltimore, Md.		
9263	Harvest Brand 4-8-4	4-8-4	Plantsville
9262	Harvest Brand 5-8-7	5-8-7	Plantsville
	Frank S. Platt Co., New Haven, Conn.		
9558	Platt's Concentrated Lawn Fertilizer	16-5-5	New Haven
9559	Platco Special 5-8-7	5-8-7	New Haven
	Rackliffe Bros. Co., Inc., New Britain, Conn.		
9500	Rackliffe Brand Corn Fertilizer 4-8-4	4-8-4	New Britain
9480	Rackliffe Brand Potato and Spec. Vegetable 5-8-7	5-8-7	New Britain
	The Rogers and Hubbard Co., Portland, Conn.		
9034	4-8-4	4-8-4	Hartford
9617	4-8-4	4-8-4	Wallingford
9035	5-8-7	5-8-7	Hartford
9620	5-8-7	5-8-7	Branford
9255	Hubbard's Bone Base Fertilizer for Seeding Down	3-5-6	Portland
9256	Hubbard's Bone Base Oats and Top Dressing	10-3-8	Willimantic
9258	Hubbard's Bone Base Soluble Corn and General Crops Manure	3-8-6	Branford
9297	Hubbard's Bone Base Soluble Potato Manure	6-8-5	Branford
9624	Hubbard's Bone Base Soluble Potato Manure	6-8-5	Glastonbury
9301	Hubbard's Bone Base Soluble Tobacco Manure	6-8-10	New Milford
9045	R & H All Soils All Crops Fertilizer	4-10-4	New Milford
9506	Rogers & Hubbard's Climax Tobacco Brand	5-3-5	Granby
9042	Rogers & Hubbard's Corn and Grain Fertilizer	1-10-3	Willimantic
9498	Rogers & Hubbard's High Potash Fertilizer	3-8-10	Branford
9041	Rogers & Hubbard's Potato Fertilizer	2-10-4	Willimantic
9300	R & H Tobacco Grower Vegetable Formula	6-3-5	Suffield

CONTAINING NITROGEN, PHOSPHORIC ACID AND POTASH—*Continued.*

Nitrogen.					Ammonia equivalent to total nitrogen.	Phosphoric Acid.			Potash.		Station No.
In Nitrates.	In Ammonia.	Organic water-soluble.	Organic water-insoluble.	Total.		Citrate-insoluble.	Total.	So-called "Available".	As muriate.	Total.	
%	%	%	%	%	%	%	%	%	%	%	%
0.06	5.18	0.29	0.08	5.61	**6.82**	0.35	6.53	**6.18**	4.66	**4.66**	9481
0.25	2.65	0.81	0.52	4.23	**5.14**	0.78	9.05	**8.27**	7.15	**7.15**	9487
0.34	1.82	0.59	0.56	3.31	**4.02**	0.65	6.55	**5.90**	10.19	**10.19**	9261
0.53	1.63	0.42	0.66	3.24	**3.94**	1.28	9.20	**7.92**	4.11	**4.11**	9263
0.04	3.08	0.47	0.36	3.95	**4.80**	0.58	8.58	**8.00**	7.22	**7.22**	9262
0.00	13.57	0.11	0.48	14.16	**17.22**	0.03	5.15	**5.12**	0.28	**5.18**	9558
0.08	2.95	0.79	0.62	4.44	**5.40**	0.98	9.65	**8.67**	7.17	**7.17**	9559
0.32	2.19	0.46	0.59	3.56	**4.33**	1.30	9.55	**8.25**	4.05	**4.05**	9500
1.54	1.98	0.44	0.16	4.12	**5.01**	0.50	9.05	**8.55**	5.57	**6.41**	9480
0.17	2.09	1.01	0.18	3.45	**4.19**	1.05	8.65	**7.60**	4.26	**4.26**	9034
0.86	1.50	0.63	0.32	3.31	**4.02**	0.38	8.53	**8.15**	4.26	**4.26**	9617
0.07	2.93	1.08	0.13	4.21	**5.12**	0.70	8.40	**7.70**	7.14	**7.14**	9035
0.05	2.93	1.07	0.13	4.18	**5.08**	0.63	8.45	**7.82**	7.00	**7.00**	9620
0.00	0.80	0.40	1.27	2.47	**3.00**	6.78	12.63	**5.85**	6.49	**6.49**	9255
4.52	0.14	3.26	0.32	8.24	**10.02**	3.28	8.43	**5.15**	2.88	**8.70**	9256
0.07	0.95	0.93	0.58	2.53	**3.08**	1.45	10.30	**8.85**	5.98	**5.98**	9258
4.08	2.16	0.83	0.95	5.02	**6.10**	1.98	10.64	**8.66**	0.73	**4.49**	9297
0.86	2.08	1.37	0.66	4.97	**6.04**	1.30	10.25	**8.95**	0.70	**4.95**	9624
0.79	2.24	1.19	0.57	4.79	**5.82**	1.13	10.38	**9.25**	2.75	**9.92**	9301
0.09	2.04	0.69	0.72	3.54	**4.30**	0.65	10.63	**9.98**	4.20	**4.20**	9045
4.23	0.05	0.23	2.62	4.13	**5.02**	0.39	3.85	**3.46**	0.64	**5.01**	9506
0.12	0.23	0.36	0.44	1.15	**1.40**	0.70	11.50	**10.80**	3.36	**3.36**	9042
0.06	1.27	0.67	0.70	2.70	**3.28**	0.78	9.38	**8.60**	10.53	**10.53**	9498
0.12	0.63	0.66	0.56	1.97	**2.40**	0.60	10.33	**9.73**	4.93	**4.93**	9041
4.43	0.09	0.66	2.86	5.04	**6.13**	0.30	3.50	**3.20**	0.46	**5.43**	9300

TABLE XII. ANALYSES OF MIXED FERTILIZERS

Station No.	Manufacturer and Brand	Grade.	Place of Sampling.
	Sampled by Station:		
	F. S. Royster Guano Co., Baltimore, Md.		
9513	Royster's Conn. Tobacco Guano	5-3-5	Granby
9294	Royster's Comet Guano	3-10-6	Granby
9296	Royster's Gem Guano	2-12-4	Thompsonville
9293	Royster's Quality Trucker	4-8-7	Granby
9295	Royster's Top Dresser	8-6-6	Granby
9290	Royster's Truckers Delight	4-8-4	Plainville
9299	Royster's 5% Truck Guano	5-8-7	Madison
9614	Royster's Valley Tobacco Guano	5-4-5	Windsor Locks
9516	Royster's Wrapper Brand 7-3-7	7-3-7	Burnside
	M. L. Shoemaker & Co., Philadelphia, Pa.		
9588	Potato Special	5-8-7	New Milford
9601	"Swift-Sure" Special Tobacco Formula	4-8-5	New Milford
9560	Tobacco and General Use	3-10-3	Granby
	Springfield Rendering Co., Springfield, Mass.		
9510	Springfield, 3-8-4	3-8-4	Thompsonville
9517	Springfield 4-8-4	4-8-4	Suffield
9515	Springfield 5-8-7	5-8-7	Hazardville
	Swift & Co., Baltimore, Md.		
9065	Vigoro	4-12-4	Waterbury
	Synthetic Nitrogen Products Co., New York.		
9605	Nitrophoska	18.2-30-15	Southington
	I. P. Thomas & Sons, Philadelphia, Pa.		
9342	Economy Fertilizer 3-12-3	3-12-3	Ansonia
9585	I. P. Thomas 5-8-7	5-8-7	Milford
9044	Long Island Special 4-8-7	4-8-7	Branford
9345	Thomas Tobacco Grower 5-4-5	5-4-5	East Granby
9584	Tip Top Superphosphate 3-10-6	3-10-6	Milford
9586	7% Guano 7-6-5	7-6-5	Milford
9344	Truckers High Grade Guano 4-8-4	4-8-4	North Haven
9581	Victor Potash Fertilizer 2-8-5	2-8-5	Hamden

CONTAINING NITROGEN, PHOSPHORIC ACID AND POTASH—*Continued.*

Nitrogen.					Ammonia equivalent to total nitrogen.	Phosphoric Acid.			Potash.		Station No.
In Nitrates.	In ammonia.	Organic water-soluble.	Organic water-insoluble.	Total.		Citrate-insoluble.	Total.	So-called "Available."	As muriate.	Total.	
%	%	%	%	%	%	%	%	%	%	%	%
0.44	0.93	0.22	2.52	4.11	**5.00**	0.20	4.08	**3.88**	0.90	**6.09**	9513
0.00	1.52	0.33	0.62	2.47	**3.00**	0.83	10.73	**9.90**	6.24	**6.24**	9294
0.06	1.16	0.28	0.34	1.84	**2.24**	0.70	13.82	**13.12**	4.06	**4.06**	9296
0.00	2.12	0.45	0.69	3.26	**3.96**	0.63	8.60	**7.97**	7.13	**7.13**	9293
2.49	3.34	0.39	0.33	6.55	**7.96**	0.20	6.85	**6.65**	6.33	**6.33**	9295
0.00	2.10	0.56	0.70	3.36	**4.09**	0.95	9.08	**8.13**	4.30	**4.30**	9290
0.00	2.46	0.81	0.80	4.07	**4.95**	0.78	9.68	**8.90**	6.66	**6.66**	9299
0.32	0.88	0.29	2.86	4.35	**5.29**	0.65	4.73	**4.08**	1.29	**5.11**	9614
0.60	1.20	0.14	3.72	5.66	**6.88**	0.08	3.65	**3.57**	0.47	**7.29**	9516
0.33	2.52	0.32	1.07	4.24	**5.15**	1.88	9.45	**7.57**	5.90	**5.90**	9588
0.00	2.10	0.12	1.32	3.54	**4.30**	0.60	9.00	**8.40**	0.28	**5.45**	9601
0.08	1.50	0.17	0.90	2.65	**3.22**	1.20	10.68	**9.48**	0.27	**3.17**	9560
0.03	1.45	0.48	0.60	2.56	**3.11**	0.79	9.18	**8.39**	4.12	**4.12**	9510
0.88	1.38	0.54	0.78	3.58	**4.35**	0.73	8.75	**8.02**	4.09	**4.09**	9517
1.20	1.68	0.74	0.54	4.16	**5.06**	1.15	10.40	**9.25**	7.17	**7.17**	9515
0.32	2.74	0.05	0.39	3.50	**4.26**	0.28	13.00	**12.72**	4.28	**4.28**	9065
0.00	13.30	1.44	0.26	15.00	**18.24**	0.00	30.30	**30.30**	15.21	**15.21**	9605
0.08	1.96	0.23	0.44	2.71	**3.29**	2.13	14.30	**12.17**	2.35	**3.25**	9342
0.46	2.96	0.31	0.69	4.42	**5.37**	1.05	9.90	**8.85**	6.43	**6.43**	9585
0.30	2.29	0.23	0.58	3.40	**4.13**	0.78	9.45	**8.67**	7.05	**7.05**	9044
0.18	0.90	0.50	2.52	4.10	**4.98**	3.20	12.00	**8.80**	0.72	**5.85**	9345
0.36	1.64	0.27	0.39	2.66	**3.23**	0.64	11.55	**10.91**	4.98	**6.16**	9584
0.34	4.06	0.42	0.72	5.54	**6.74**	0.50	7.55	**7.05**	4.48	**5.29**	9586
0.46	2.08	0.35	0.71	3.60	**4.38**	0.85	9.72	**8.87**	3.38	**3.78**	9345
0.08	1.18	0.12	0.40	1.78	**2.16**	1.35	9.68	**8.33**	4.19	**4.68**	9581

TABLE XII. ANALYSES OF MIXED FERTILIZERS

Station No.	Manufacturer and Brand.	Grade.	Place of Sampling.
	Sampled by Station:		
	Triton Oil and Fertilizer Co., New York.		
9339	Triton 4-8-4 Fertilizer	4-8-4	Milford
9349	Triton 4-8-7 Fertilizer	4-8-7	New London
9348	Triton 5-8-5 Fertilizer	5-8-5	New London
9340	Triton 5-8-7 Fertilizer	5-8-7	Milford
	U. S. Guano Co., Baltimore, Md.		
9186	Accomac Peninsular King	5-8-5	No. Haven
9188	General Use Guano	2-12-4	No. Haven
9185	Jersey Special	4-8-10	No. Haven
9187	Royal Potato Grower	4-8-7	No. Haven
8847	Standard United States Evergreen Fish Guano	4-8-4	Norwalk
8851	Standard United States Fish, Bone and Potash	5-8-7	Southport
8848	Standard United States Old Fertility	2-8-3	Norwalk
9184	Standard United States 5-10-5	5-10-5	Orange
	Virginia-Carolina Chemical Co., New York.		
9350	Bloomaid	6-10-4	Mfg's Sample
8881	V. C. Aroostook Potato Grower	5-8-7	New Britain
8880	V. C. Fish and Potash Compound	2-9-3	New Britain
8874	V. C. XXXX Fish and Potash	4-8-4	New Britain
	Wilcox Fertilizer Co., Mystic, Conn.		
9347	Wilcox Corn Special 3-10-4	3-10-4	Willimantic
9346	Wilcox H. G. Fish and Potash 4-8-4	4-8-4	Willimantic
9359	Wilcox Potato and Vegetable Phospate 5-8-7	5-8-7	Willimantic
9355	Wilcox 7-6-5 Top Dresser	7-6-5	Mystic
	Worcester Rendering Co., Auburn, Mass.		
9356	Prosperity Brand Complete Dressing	6-6-4	Groton
56	Prosperity Brand Complete Dressing	6-6-4	Colchester
9040	Prosperity Brand Corn and Grain Fertilizer	2-10-2	Colchester
58	Prosperity Brand Corn and Grain Fertilizer	2-10-2	Putnam
9352	Prosperity Brand Market Garden Fertilizer	5-8-7	Colchester
57	Prosperity Brand Market Garden Fertilizer	5-8-7	Groton
9043	Prosperity Brand Potato and Vegetable Fertilizer	4-8-4	Groton

CONTAINING NITROGEN, PHOSPHORIC ACID AND POTASH—*Continued.*

Nitrogen.					Ammonia equivalent to total nitrogen.	Phosphoric Acid.			Potash.		Station No.
In Nitrates.	In Ammonia.	Organic water-soluble.	Organic water-insoluble.	Total.		Citrate-insoluble.	Total.	So-called "Available".	As muriate.	Total.	
%	%	%	%	%	%	%	%	%	%	%	%
.73	1.30	0.48	0.64	3.15	**3.83**	0.37	8.52	**8.15**	4.69	**4.69**	9339
.73	1.53	0.50	0.59	3.35	**4.07**	0.30	9.03	**8.73**	7.34	**7.34**	9349
.85	1.98	0.56	0.76	4.15	**5.05**	0.48	9.50	**9.02**	5.02	**5.02**	9348
.26	1.99	0.46	0.92	4.63	**5.63**	0.23	9.28	**9.05**	7.21	**7.21**	9340
.28	0.34	2.18	0.15	3.95	**4.80**	0.55	8.77	**8.22**	4.13	**4.86**	9186
.70	1.50	0.12	0.30	2.62	**3.19**	0.68	11.12	**10.44**	4.03	**4.32**	9188
.52	0.22	0.29	0.22	3.25	**3.95**	0.19	8.63	**8.44**	10.16	**10.16**	9185
.30	1.22	0.28	0.52	3.32	**4.04**	0.83	9.07	**8.24**	6.73	**6.73**	9187
.00	2.84	0.06	0.52	3.42	**4.16**	0.40	8.85	**8.45**	3.93	**4.81**	8847
.22	3.50	0.01	0.54	4.27	**5.19**	0.48	8.85	**8.37**	6.43	**6.43**	8851
.18	1.00	0.04	0.72	1.94	**2.36**	0.73	9.85	**9.12**	3.08	**3.08**	8848
.60	2.72	0.36	0.22	3.90	**4.74**	0.48	11.00	**10.52**	4.76	**4.76**	9184
						0.65	11.45	**10.80**	0.76	**4.96**	9350
.11	2.75	0.22	1.16	5.24	**6.37**	1.10	9.30	**8.20**	6.66	**6.66**	8881
.00	2.78	0.60	0.69	4.07	**4.95**	1.08	9.93	**8.85**	4.54	**4.54**	8880
.15	1.07	0.39	0.50	2.11	**2.57**	0.73	8.30	**7.57**	4.29	**4.29**	8874
.93	2.20	0.00	0.34	3.47	**4.22**						
.34	0.10	0.55	0.70	2.69	**3.27**	0.73	10.98	**10.25**	3.40	**4.11**	9347
.73	0.26	0.91	0.78	3.68	**4.47**	0.58	8.16	**7.58**	3.90	**4.66**	9346
.26	1.36	0.43	0.71	3.76	**4.57**	0.54	9.00	**8.46**	7.40	**7.40**	9359
.55	1.71	0.72	0.32	5.30	**6.44**	0.20	7.05	**6.85**	2.98	**5.25**	9355
.67	2.83	0.49	0.50	4.49	**5.46**	0.83	7.30	**6.47**	4.01	**4.01**	9356
....	.....	.....	.....	4.87	**5.92**	0.64	7.07	**6.43**	.....	**4.34**	56
.21	0.76	0.58	0.35	2.90	**3.53**	0.95	10.70	**9.75**	2.07	**2.07**	9040
....	.....	.....	.....	2.29	**2.78**	1.05	12.04	**10.99**	.....	**2.50**	58
.77	2.23	0.67	0.64	4.31	**5.24**	0.95	8.48	**7.53**	7.75	**7.75**	9352
....	.....	.....	.....	4.22	**5.13**	0.84	7.88	**7.04**	.....	**6.85**	57
.82	1.34	0.64	0.46	3.26	**3.96**	1.10	9.43	**8.33**	3.90	**3.90**	9043

TABLE XII. ANALYSES OF MIXED FERTILIZERS

Station No.	Manufacturer and Brand.	Grade.	Place of Sampling.
	Sampled by Purchaser:		
	Berkshire Chemical Co., Bridgeport, Conn.		
9527	Complete Tobacco Fertilizer	5-3-5	Suffield
	Lowell Fertilizer Co., Boston, Mass.		
8085	Lowell 5-10 5	5-10-5	Storrs
	The Rogers & Hubbard Co., Portland, Conn.		
8916	Tunacre Fertilizer	.....	Middletown
	Swift & Co., Baltimore, Md.		
9018	Vigoro	4-12-4	Norwich
	Standard Wholesale Phosphate & Acid Works, Baltimore, Md.		
8254	5-8-7 Fertilizer	5-8-7	New Britain
8255	4-8-4 Fertilizer	4-8-4	New Britain
9052	Standard United States Buyers Mixture Fertilizer	.....	Andover
9053	Standard United States Buyers Mixture Fertilizer	.....	Andover
9058	Standard United States Fish, Bone and Potash.	5-8-7	Andover
9492	Standard United States Fish, Bone and Potash.	5-8-7	Rockville
9252	Standard United States Fish, Bone and Potash.	5-8-7	Bridgeport
9253	Standard United States Fish, Bone and Potash.	5-8-7	Bridgeport
	Wilcox Fertilizer Co., Mystic, Conn.		
9119	Wilcox Fertilizer 4-8-4	4-8-4	Norwich
9120	Wilcox Fertilizer 5-8-7	5-8-7	Norwich
9055	Wilcox Fertilizer 7-6-5	7-6-5	Andover

CONTAINING NITROGEN, PHOSPHORIC ACID AND POTASH—*Continued.*

Nitrogen.					Ammonia equivalent to total nitrogen.	Phosphoric Acid.			Potash.		Station No.
in Nitrates.	In ammonia.	Organic water-soluble.	Organic water-insoluble.	Total.		Citrate-insoluble.	Total.	So-called "Available".	As muriate.	Total.	
%	%	%	%	%	%	%	%	%	%	%	%
..	....	....	....	4.61	**5.60**	0.20	3.65	**3.45**	0.93	**4.78**	**9527**
..	....	....	....	4.22	**5.13**	0.97	11.19	**10.22**	....	**5.27**	**8085**
..	....	....	....	8.15	**9.91**	0.18	4.73	**4.55**	....	**10.54**	**8916**
..	....	....	....	3.42	**4.16**	0.33	13.05	**12.72**	....	**4.07**	**9018**
..	....	....	....	4.38	**5.33**	0.84	8.88	**8.04**	5.07	**5.07**	**8254**
..	....	....	....	3.38	**4.11**	0.71	8.94	**8.23**	4.21	**4.21**	**8255**
..	....	....	....	5.20	**6.32**	1.13	8.28	**7.15**	7.04	**7.04**	**9052**
..	....	....	....	4.25	**5.17**	0.60	11.00	**10.40**	4.31	**4.94**	**9053**
..	....	....	....	4.14	**5.03**	0.43	8.50	**8.07**	6.66	**7.01**	**9058**
..	....	....	....	4.00	**4.86**	....	9.05	....	6.13	**6.13**	**9492**
..	....	....	....	4.37	**5.31**	0.55	8.65	**8.10**	6.45	**6.79**	**9252**
..	....	....	....	4.25	**5.17**	0.48	8.50	**8.12**	6.43	**6.60**	**9253**
..	....	....	....	3.37	**4.10**	0.18	9.03	**8.95**	3.18	**4.24**	**9119**
..	....	....	....	4.31	**5.24**	0.05	8.53	**8.48**	7.45	**7.45**	**9120**
..	....	....	....	5.66	**6.88**	0.23	6.88	**6.65**	4.59	**5.61**	**9055**

SPECIAL MIXTURES AND HOME MIXTURES.

Fifty samples of mixed fertilizers have been examined for individuals such samples for the most part being drawn by the persons interested. The Station is responsible only for the analysis of these samples as received.

Analyses are given in Table XVI.

VIII. MISCELLANEOUS FERTILIZERS, AMENDMENTS, WASTE PRODUCTS, ETC.

SHEEP MANURE, ETC.

Twenty-six samples of sheep manure and other farm manures were analyzed. The identity of two of these products is uncertain. Nos. **8959** and **9495** did not have the appearance of sheep manure and did not contain appreciable amounts of phosphoric acid or potash.

Analyses are given in Table XVII.

LIME.

Lime is not classed as a fertilizer in this State but seven samples have been analyzed for purchasers. The results are given in Table XVIII.

OTHER MISCELLANEOUS MATERIALS.

Other miscellaneous materials, 35 in number, have been examined during the year and the results, with comments where necessary, are given in Table XIX.

COLLABORATIVE WORK.

The laboratory has collaborated in the check meal program of the American Oil Chemists' Society, and in the check fertilizer program sponsored by the F. S. Royster Guano Co. Mr. Nolan has collaborated with the Referee of the Association of Official Agricultural Chemists upon methods for determining activity of insoluble organic nitrogen in fertilizers. This work has involved the examination of 45 samples.

TABLE XVI. ANALYSES OF SPECIAL AND HOME MIXTURES.

Station No.	Manufacturer or Brand.	Place of Sampling.	Total Nitrogen.	Ammonia equivalent to total nitrogen.	Phosphoric Acid.			Potash.		Station No.
					Citrate-insoluble.	Total.	So-called "Available".	As muriate.	Total.	
	Sampled by Station.		%	%	%	%	%	%	%	
9667	Sanderson's Formula B (Old Stock)	John B. Laydon, North Haven.	3.34	**4.06**	0.25	8.43	**8.18**	1.28	**6.75**	**9667**
9596	Special Mixture for Tobacco	Chas. Maag, Manchester	6.52	**7.93**	0.08	2.38	**2.30**	0.40	**7.35**	**9596**
9534	Home Mixture for Corn	E. N. Austin, Suffield	3.74	**4.55**	0.18	4.86	**4.68**	5.23	**5.23**	**9534**
9594	Home Mixture for Corn	John Luginbuhl, Ellington	3.90	**4.74**	0.15	3.68	**8.85**	3.68	**3.68**	**9594**
9603	Home Mixture for Potatoes	John Luginbuhl, Ellington	4.54	**5.52**	1.68	8.73	**7.05**	4.05	**4.05**	**9603**
9604	Home Mixture for Grass	John Luginbuhl, Ellington	6.88	**8.36**	0.08	6.35	**6.27**	6.07	**6.07**	**9604**
9768	Wilcox 4-8-4 Fertilizer	P. Cutler, Inc., Colchester	3.17	**3.85**	0.10	8.58	**8.48**	3.43	**4.26**	**9768**
9771	Wilcox 5-8-7 Fertilizer	W. A. Howard, Woodstock	4.04	**4.91**	0.13	8.33	**8.20**	7.36	**7.36**	**9771**
9770	Wilcox 5-10-5 Fertilizer	H. F. Joy, Woodstock	4.18	**5.08**	0.35	10.55	**10.20**	4.90	**4.90**	**9770**
9579	Woodruff Home Mixture	S. D. Woodruff & Sons, Orange	4.00	**4.86**	1.10	7.48	**6.38**	7.19	**7.19**	**9579**

TABLE XVI. ANALYSES OF SPECIAL AND HOME MIXTURES—*Concluded.*

Station No.	Manufacturer or Brand.	Place of Sampling.	Total Nitrogen.	Ammonia equivalent to total nitrogen.	Phosphoric Acid.			Potash.		Station No.
					Citrate-insoluble.	Total.	So-called "Available".	As muriate.	Total.	
	Sampled by Purchaser.		%	%	%	%	%	%	%	
9013	Special Mixture Fertilizer..	The Allied Tobacco Co., Hartford.....	6.41	7.79	0.33	1.85	1.52	....	11.87	9013
8263	Formula A.....	American Sumatra Tobacco Co., Bloomfield.....	6.00	7.29	0.65	5.24	4.59	....	4.76	8263
8337	Formula A.....	American Sumatra Tobacco Co., Bloomfield.....	6.02	7.32	0.48	4.69	4.21	....	5.08	8337
8262	Formula B.....	American Sumatra Tobacco Co., Bloomfield.....	5.36	6.52	1.11	6.30	5.19	....	6.54	8262
8302	Formula B.....	American Sumatra Tobacco Co., Bloomfield.....	5.46	6.64	1.06	6.05	4.99	0.25	6.22	8302
8343	Formula C.....	American Sumatra Tobacco Co., Bloomfield.....	5.90	7.17	0.82	4.73	3.91	....	3.91	8343
8458	Formula E.....	American Sumatra Tobacco Co., Bloomfield.....	4.98	6.05	0.45	3.48	3.03	....	5.79	8458
8816	Formula F.....	American Sumatra Tobacco Co., Bloomfield.....	5.70	6.93	0.28	5.23	4.95	....	4.56	8816
8920	Formula G.....	American Sumatra Tobacco Co., Bloomfield.....	5.36	6.52	0.38	3.63	3.25	....	5.79	8920
8344	Drill Fertilizer.....	American Sumatra Tobacco Co., Bloomfield.....	9.77	11.88	0.22	2.04	1.82	....	1.07	8344
8006	Fall Top Bed Fertilizer....	American Sumatra Tobacco Co., Bloomfield.....	5.44	6.61	0.65	4.72	4.07	....	5.80	8006

TABLE XV ANALYSES OF SPECIAL AND HOME MIXTURES.

Station No.	Manufacturer or Brand.	Place of Sampling.	Total Nitrogen.	Ammonia equivalent to total nitrogen.	Phosphoric Acid.			Potash.		Station No.
					Citrate-insoluble.	Total.	So-called "Available".	As muriate.	Total.	
	Sampled by Purchaser.		%	%	%	%	%	%	%	
8692	Apothecaries Hall Co., Waterbury, Car No. 168774.	Hatheway & Steane, Inc., Hartford	4.12	5.01	0.30	8.58	8.28	....	7.05	8692
9629	Home Mixture	E. N. & C. C. Austin, Suffield	4.78	5.81	....	4.60	....	....	5.45	9629
9351	Nature's Own Fertilizer., Bestivall Mfg. Co., Philadelphia, Pa	Mfr.'s Sample	7.50	9.12	....	1.80	....	....	0.99	9351
9463	Special Mixture Fertilizer	William J. Burgess, Thompsonville	6.37	7.74	0.43	4.53	4.10	0.62	6.91	9463
9048	Fertilizer	Daigle Bros., Marion	4.68	5.69	0.50	10.53	10.03	....	6.95	9048
9572	Eastern States Farmers' Exchange, Springfield, Mass.	Leslie W. Newberry, So. Windsor	6.06	7.37	0.05	4.73	4.68	0.32	7.43	9572
9654	Special Mixture Fertilizer	J. E. Phelps, Suffield	4.86	5.91	1.90	6.78	4.88	0.52	5.04	9654
9535	Home Mixed Fertilizer	The Hartman Tobacco Co., Hartford	6.96	8.46	0.40	3.44	3.04	0.21	6.47	9535
7786	Platt's Concentrated Lawn Fertz., Frank S. Platt Co. New Haven	Mfr's Sample	15.86	19.28	....	...	. .	....	....	7786

TABLE XV ANALYSES OF SPECIAL AND HOME MIXTURES—*Continued.*

Station No.	Manufacturer or Brand.	Place of Sampling.	Total nitrogen.	Ammonia equivalent to total nitrogen.	Phosphoric Acid.			Potash.		Station No.
					Citrate-insoluble.	Total.	So-called "Available".	As muriate.	Total.	
	Sampled by Purchaser.		%	%	%	%	%	%	%	
9395	Special Mixture Fertilizer No. 3	H. E. Wells, Warehouse Point..	6.25	7.60	0.10	7.30	7.20	1.04	15.89	9395
9396	Special Mixture Fertilizer No. 4	H. E. Wells, Warehouse Point..	6.22	7.56	0.15	7.38	7.23	0.80	16.43	9396
9397	Special Mixture Fertilizer No. 5	H. E. Wells, Warehouse Point..	5.00	6.08	0.55	6.00	5.45	6.67	6.85	9397
9398	Special Mixture Fertilizer No. 6	H. E. Wells, Warehouse Point..	3.60	4.38	0.83	8.13	7.30	5.25	5.43	9398
8297	Complete Fertilizer Grower	The Rogers & Hubbard Co., Portland	4.91	5.97	0.32	3.41	3.09	....	5.19	8297
8376	"Climax" Fertilizer	The Rogers & Hubbard Co., Portland	4.27	5.19	0.50	4·02	3.52	....	5.08	9376
9716	5-8-7 Fertilizer No. 1	The Rogers & Hubbard Co., Portland	4.18	5.08	0.33	8.70	8.37	7.27	7.27	9716
9717	5-8-7 Fertilizer No. 2	The Rogers & Hubbard Co., Portland	4.21	5.12	0.35	8.50	8.15	7.28	7.28	9717
9666	Special Mixture Fertilizer..	Paul P. Rostek, Melrose	6.04	7.34	....	4.05	....	1.20	6.55	9666

TABLE XV. ANALYSES OF SPECIAL AND HOME MIXTURES—*Concluded.*

Station No.	Manufacturer or Brand.	Place of Sampling.	Total nitrogen.	Ammonia equivalent to total nitrogen.	Phosphoric Acid.			Potash.		Station No.
					Citrate-insoluble.	Total.	So-called "Available".	As muriate.	Total.	
	Sampled by Purchaser.		%	%	%	%	%	%	%	
9709	Special Home Mixture (Rosenblum)	Consolidated Cigar Co., Hartford	5.83	**7.09**	0.68	3.65	**2.97**	0.74	**6.35**	9709
9710	Special Home Mixture (Myers)	Consolidated Cigar Co., Hartford	6.16	**7.49**	0.45	4.40	**3.95**	0.03	**4.43**	9710
9711	Special Home Mixture (Shaker)	Consolidated Cigar Co., Hartford	6.40	**7.78**	0.55	4.40	**3.85**	0.04	**4.21**	9711
9712	Special Home Mixture (Winton)	Consolidated Cigar Co., Hartford	5.92	**7.20**	0.90	3.95	**3.05**	0.33	**6.19**	9712
9713	Special Home Mixture (Kanter)	Consolidated Cigar Co., Hartford	6.02	**7.32**	0.38	3.65	**3.27**	0.49	**4.12**	9713
9714	Special Home Mixture (Huntting)	Consolidated Cigar Co., Hartford	6.14	**7.47**	0.58	4.58	**4.00**	0.11	**4.47**	9714
9715	Special Home Mixture (Barton)	Consolidated Cigar Co., Hartford	5.80	**7.05**	0.40	4.18	**3.78**	0.24	**6.21**	9715
7997	Fertilizer No. 1	Truman H. Hale, Gildersleeve..	5.62	**6.83**	0.97	4.39	**3.42**	....	**5.39**	7997
7998	Fertilizer No. 2	Truman H. Hale, Gildersleeve..	5.78	**7.03**	0.91	4.27	**3.36**	....	**5.72**	7998
8096	Fertilizer	S. D. Woodruff & Sons, Orange	.45	**1.76**	1.35	8.30	**6.95**	....	**11.36**	8096
8341	Clay's Fertilizer	J. P. Johnson, Entomology Dept.	4.87	**5.92**	6.65	9.66	**3.01**	....	**0.16**	8341

TABLE XVII. ANALYSES OF

Station No.	Manufacturer or Brand.	Place of Sampling.
	Sampled by Station.	
8870	A. A. C. Pulverized Sheep and Goat Manure. American Agricultural Chemical Co., New York	Bristol Grain & Supply C Bristol
9189	Sheep Manure. Apothecaries Hall Co., Waterbury	F. T. Blish Hardware Co., Manchester
9028	Armour's Sheep and Goat Manure 1½-1-2. Armour Fertilizer Works, New York	F. A. Bartlett Tree Expert C Stamford
8959	Berkshire Sheep Manure. Berkshire Chemical Co., Bridgeport	Eldredge Hardware Co., N wich
9540	Par Plus Brand Pulverized Sheep Manure. A. H. Case & Co., Buffalo, N. Y	S. D. Woodruff & Son, Oran
8886	Corenco Sheep Manure. Consolidated Rendering Co., Boston, Mass	Cheshire Reformatory, Chesh
8999	Davey Shredded Cattle Manure, Davey Tree Expert Co., Kent, Ohio	R. E. Landis, Sound Beach
9495	Sheep Manure. Meech & Stoddard, Inc., Middletown	Meech & Stoddard, Middleto
9021	"Sheep's Head" Pulverized Sheep Manure. Natural Guano Co., Aurora, Ill	Cadwell & Jones, Hartford
9479	Favorite Brand Sheep Manure. Olds & Whipple, Inc., Hartford	Sampled at factory
9257	Groz-It Brand (Pulverized Sheep Manure). Pacific Manure & Fertilizer Co., San Francisco, Cal	F. F. Hitchcock Co., Woodb
8903	Premier Brand Poultry Manure, Premier Poultry Manure Co., Chicago, Ill	Lightbourn & Pond, New Ha
8904	Premier Brand Sheep Manure. Premier Premier Poultry Manure Co., Chicago, Ill.	Lightbourn & Pond, New Ha
8905	Wizard Brand Pulverized Sheep Manure. Pulverized Manure Co., Chicago, Ill	Comstock-Ferre & Co., We ersfield
8989	Wizard Brand Pulverized Sheep Manure. Pulverized Manure Co., Chicago, Ill	H. E. Meeker, Danbury
9264	Wizard Cattle Manure. Pulverized Manure Co., Chicago, Ill	S. P. Strople, New Britain
9292	Sheep Manure. The Rogers & Hubbard Co., Portland	W. L. Richmond, New Milfo
9496	Royster's Sheep & Goat Manure. F. S. Royster Guano Co., Baltimore, Md	F. B. Newton, Plainville
9583	Sheep and Goat Manure. I. P. Thomas & Son, Philadelphia, Pa	Ira W. Beers, Hamden
	Sampled by Purchaser.	
7656	Poultry Manure	Z. N. Beach, Wallingford
9755	Poultry Manure[1]	Charter Bros., Stafford Sprin
9655	Chicken Manure	Raymond C. Bugbee, Groto
9056	Favorite Brand Sheep Manure. Olds & Whipple, Inc., Hartford	J. A. Barrasso, Andover
8324	Chicago Stock Yard Sheep Manure. Pulverized Manure Co., Chicago, Ill	Geo. C. Meachen, Stratford
8325	Venezuelan Goat Manure. Summer Fertilizer Co., Baltimore, Md	Geo. E. Meachen, Stratford
8008	Sheep Manure. S. D. Woodruff & Sons, New York	Mfr.'s Sample

[1] 16.93% moisture.

Sheep Manure, Etc.

Total Nitrogen.	Ammonia equivalent to total nitrogen.		Phosphoric acid.				Potash.		Station No.
			Available.		Total				
	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	
%	%	%	%	%	%	%	%	%	
1.47	1.79	1.50	1.67	0.50	1.90	....	3.10	2.00	8870
2.93	3.56	1.80	....	....	2.93	1.00	2.52	2.00	9189
1.64	1.99	1.50	0.80	....	1.45	1.00	3.36	2.00	9028
3.02	3.67	3.00	....	....	....	....	....	....	8959
2.29	2.78	2.25	....	....	3.08	1.50	1.65	1.50	9540
1.67	2.03	1.50	....	....	1.20	0.50	3.26	2.00	8886
1.86	2.26	1.27	1.40	1.00	1.78	1.00	2.71	1.00	8999
3.08	3.74	3.52	0.15	0.23	0.30	....	0.12	0.12	9495
1.84	2.24	2.73	1.08	1.00	1.93	1.25	2.32	2.00	9021
1.36	1.65	1.65	....	....	1.00	0.75	2.75	2.50	9479
1.47	1.79	1.82	0.75	0.75	0.95	1.25	3.04	3.00	9257
4.86	5.91	6.10	2.38	2.50	2.53	2.75	1.20	1.30	8903
1.87	2.27	2.00	0.93	0.80	1.08	1.00	2.09	2.00	8904
1.78	2.16	2.43	1.03	1.25	1.28	....	2.77	2.00	8905
2.23	2.71	2.43	1.68	1.25	1.78	....	2.72	2.00	8989
2.04	2.48	2.10	1.30	1.00	1.60	....	1.58	1.00	9264
2.50	3.04	2.25	....	....	1.28	....	1.72	1.50	9292
1.76	2.14	2.00	1.20	1.00	1.40	....	3.68	2.00	9496
1.24	1.51	1.50	....	....	2.00	1.00	2.24	2.00	9583
2.19	2.66	....	....	....	3.92	....	1.38	....	7656
2.58	3.14	....	....	....	3.05	....	1.30	....	9755
1.84	2.24	....	....	....	3.88	....	1.69	....	9655
1.50	1.82	1.65	....	....	1.10	0.75	3.28	2.50	9056
2.03	2.47	....	....	....	1.47	....	2.35	....	8324
1.66	2.02	....	....	....	1.28	....	3.45	....	8325
4.26	5.18	....	....	....	0.26	....	0.12	....	8008

TABLE XVIII. ANALYSES OF

Station No.	Manufacturer or Brand.	Sampled by.
	American Lime & Stone Co., Bellefonte, Pa.	
8610	Lime	Blue Hills Farm, Wallingford
	The Connecticut Agstone Co., Danbury.	
9051	Limestone	J. A. Barrasso, Andover
	Grangers Mfg. Co., West Stockbridge, Mass.	
9222	Grangers Agricultural Limestone	Mehmel & Sarvi, Plantsville
9254	Grangers Lime	C. R. Treat, Orange
	Lee Lime Corporation, Lee, Mass.	
8081	Limestone, unground	W. L. Wallace, Canaan
	Manufacturer Unknown.	
8266	Lime	E. C. P. Sanger, Falls Village
9573	Limestone	John Swanson, Bolton

Limestone, Etc.

Chemical Analysis.						Mechanical Analysis.					Station No.
Lime (CaO).		Magnesia (MgO).		Total Oxides.	Insoluble in acid.	20 mesh.	40 mesh.	50 mesh.	80 mesh.	100 mesh.	
Found.	Guaranteed.	Found.	Guaranteed.								
%	%	%	%	%	%	%	%	%	%	%	
.38	.....	0.94	.....	72.32	.....	.....	.....	.....	.....	....	8610
.67	.....	4.51	.....	44.18	.....	93.0	83.0	73.0	58.0	28.0	9051
....	.....	.....	.....	.....	.....	97.0	87.0	75.0	61.0	57.0	9222
.39	.....	6.98	.....	48.37	.....	100.0	100.0	99.8	93.5	85.0	9254
.08	.....	0.41	.....	55.49	.....	.....	.....	.....	.....	....	8081
2.85	.....	20.45	.....	50.30	.....	.....	.....	.....	.....	....	8266
4.91	.....	0.33	.....	47.24	.....	50.0	38.0	24.0	14.0	12.0	9573

TABLE XIX. MISCELLANEOUS MATERIALS.

No.	Material	Nitrogen	Phosphoric acid	Potash	Remarks
		%	%	%	
8041	Ashes from corn cobs.....	....	6.98	13.96	.....
9050	Cottonhull bran.....	0.48	0.20	1.23	.....
7972	Cottonseed hulls.....	0.74	0.11	1.11	.....
8007	Cottonseed hulls.....	0.60	0.24	1.14	.....
8078	Cottonseed hulls.....	0.79	0.05	1.05	.....
9571	Cottonseed meal.....	6.21	....	....	Check test for another laboratory.
9046	Fertilizer.....	....	....	....	Identified as precipitated bone.
9047	Fertilizer.....	....	....	....	Mixture of limestone and burned lime.
9088	Fertilizer.....	....	....	....	Identified as muriate of potash.
9406	Fertilizer.....	....	....	....	Nitrate of potash or nitrate of soda and potash.
8042	Fertilizer (cottonseed cake)	3.94	....	....	.....
8625	"Fertilizer" (Lawn).....	....	....	....	Limestone. CaO 49.12%, MgO 2.08%
9508	Fertilizer, mixed.....	....	....	....	Identified as acid phosphate.
9536	Fertilizer, mixed.....	....	....	....	Thought to have caused injury to tobacco plants. No borax found and only 0.16% of chlorine.
9687, 9688	Fertilizer, mixed.....	....	....	....	Microscopic examination only.
9763	Fertilizer, mixed.....	....	....	....	Microscopic examination only.
9724	Fertilizer (tankage).....	....	....	....	Microscopic examination. Only meat and bone detected. Chlorine 0.44%, sulphuric acid, none.

TABLE XIX. MISCELLANEOUS MATERIALS—*Concluded.*

No.	Material	Nitrogen	Phosphoric acid	Potash	Remarks
		%	%	%	
8845	Fish (whole)	2.75	3.30	....	Water and oil 72.70%.
9734	Humus	....	....	....	Moisture 27.69%, ash 1.71%, organic matter 70.60%.
9302	Lime, hydrated	....	....	....	Passed 300 mesh, 94.1%.
8110	Manganese sulphate	....	....	....	Contained 33.92% MnO.
9689	Mineral	....	....	....	Identified by Dept. of Minerology, Yale University, as blast furnace slag.
8286	Molasses waste	0.15	0.03	0.40	Analysis on material as submitted. Solids 7.51%. Plant food in a ton worth about $1.50.
9638	Nova Scotia Plaster	....	....	....	CaO 33.25%. MgO none or trace.
9733	Sheep Manure	....	....	....	Moisture 12.00%, ash 39.35%, organic matter 48.65%.
9049	Soy bean meal	7.95	1.43	2.11	.....
9063	Sulphur, dusting	....	....	....	All passed 300 mesh.
9064	Sulphur, dusting	....	....	....	73% passed 300 mesh.
8043	Tobacco dust	1.36	0.05	1.72	Nicotine 0.56%.
8068	Tobacco dust	....	....	....	Nicotine 1.62%.
7941	Tobacco leaves, deposit on.	....	....	....	Partly silica. Not completely identified.
7699	Tobacco stems	2.21	0.75	5.11	.....
9219	Tobacco stems	2.58	0.80	9.66	.....
9491	Volcanic deposit	none	trace	trace	Water 0.71%, ash 95.16%, organic and volatile 4.13%.

Bulletin 297 November, 1928

Connecticut Agricultural Experiment Station
New Haven, Connecticut

THE EFFECT
OF
TOPPING AND SUCKERING
ON
HAVANA SEED TOBACCO

Being a Report
of the
Tobacco Sub-Station
at
Windsor

Note to Librarians

The separate series, "Tobacco Station Bulletins" has been discontinued, No. 10 being the last. Hereafter, reports of the Tobacco Substation will be included in the regular Station series, this bulletin, No. 297 being the first to so appear.

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Topping and Suckering Practices As Related to the Yield and Quality of Havana Seed Tobacco

N. T. Nelson[1]

The maturity of a tobacco leaf probably determines quality to a greater extent than any other single factor. The accepted practice among tobacco growers is to go through the crop some time during the blossoming period and break off the tops. The purpose of this operation is to hasten the development of the leaves by retarding or preventing the formation of seeds. Since rapid and important changes are occurring in all plants during the blossoming period, it would seem that the grower had a powerful means of either retarding or accelerating these chemical changes by topping. Similar results (1) have been found to hold true for such plants as alfalfa, timothy, bluegrass and redtop. Important effects (2) also have been obtained by removal of young fruits from the tomato, and much work on the effects of pruning fruit trees have been reported indicating similar trends. All of these experiments indicate that pruning has an important influence on plant growth. Topping and suckering of tobacco is in fact a pruning operation and therefore should exert a marked influence on the metabolic changes occuring in the plant during the period of ripening.

Among tobacco growers there is considerable variation in the time when topping is done and the size of the portion removed from the plant. The time of topping varies from the bud to the full bloom stages. Also, the number of leaves allowed to remain on the plant varies from twelve to eighteen. In view of the results obtained on other plants this operation, as well as the frequency of suckering, should be standardized to such a time and manner so as to permit the most profitable production of leaf by the plant.

Considerably greater difficulty is encountered in determining the most favorable degree of ripeness with the stalkcut than with those varieties which are primed. The primed leaves are picked when the grower judges they are ripe; but the stalk cut varieties, such as Havana seed and Broadleaf, are harvested when the plant as a whole represents the best quality. Therefore, although rules may be laid down as to when certain operation are to be done, the grower must exercise good judgment to obtain best results.

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Review of Literature

In reviewing the work of other investigators on topping and suckering of tobacco, one is impressed with the apparent disagreement in conclusions reached. For instance, Olson (3) of Pennsylvania, obtained increased yields from high topping as compared with low topping. Johnson (4) of Wisconsin, found that high topping did not necessarily increase the yield. Low topping is advocated by some workers as the most satisfactory; others maintain that low topping produces coarse, low-quality tobacco. In regard to suckering, Olson (3) finds that two suckerings improved the quality of Pennsylvania tobacco, whereas Kentucky workers (5) (6) find that a lighter, thinner leaf is produced with less suckering. In the Pennsylvania experiments covering a period of ten years. the results on height of topping were measured in terms of yield only, nothing specific being stated regarding the effect on quality. In their suckering experiments, however, during 1912 and 1913 the best yield and also the best quality was obtained on the plots suckered twice. The plots suckered once not only gave inferior quality but the yields averaged over 300 pounds less per acre.

These illustrations are typical of the diversity of results on experiments in this country relative to the effects of topping and suckering on the yield and quality of tobacco. Experimental workers are more or less agreed that low topping reduces the variability in the size of the leaves and tends to hasten maturity. The evidence also indicates that a thick, heavy-bodied leaf, better adapted for use as a filler or a cheap binder is produced by frequent suckering.

Plan of Experiments.

Purpose.—An attempt was made to determine the relation between common practices of topping and suckering and the subsequent yield and quality of the crop. Experiments were begun at the Connecticut Tobacco Substation in 1925 and continued for three years.

Stages of topping.—Four stages of plant growth were selected, namely: bud, early bloom, full bloom and seed pod. The *bud stage* was when the top of the plant had elongated to a considerable extent, but the upper stem portion was still succulent. This somewhat immature stage was about three or four days before blossoming commenced. The *early bloom* stage was when the first blossom opened. The upper stem was more rigid than it was in the bud stage but was still somewhat succulent and could be broken easily. The *full bloom* stage was represented by an advanced maturity of three or four days when fifteen to twenty blossoms were open. At this stage the stem had become somewhat stiff and woody. The *seed pod* stage was not topped, nor suckered, until the day of

harvest. This stage represents the normal growth and development of the plant. This stage was used as a standard, any deviations from which indicate the extent to which the plant can be changed.

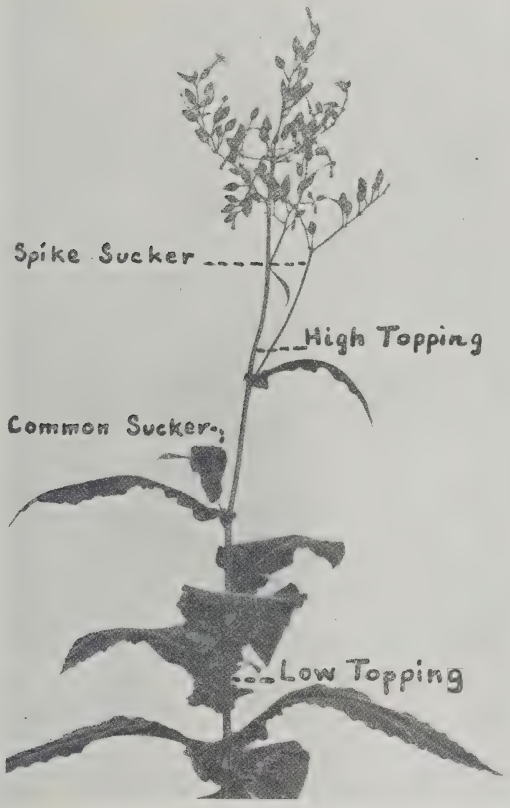

FIGURE 1.

Top portion of a tobacco plant showing the bare, leafless, spikelike stem of the lowest "spike" sucker. This is sometimes called the "bald" sucker. The ordinary or common suckers growing lower on the stalk have two or more leaves. *High topping*, as used in the text, refers to plants topped at the internode immediately above the "spike" sucker; *low topping* is four leaves below this.

Height of topping. All references to *high topping* as used in this work refer to plants at such a height that approximately eighteen leaves were allowed to remain on the plant after topping. The

point selected was the internode above the so-called "spike" sucker, sometimes called the lowest "bald" sucker. (See Figure 1.) The "spike" sucker is the lowest sucker having a bare, leafless, spike-like stem. All suckers below this have two or more leaves. Topping in the above manner is referred to in this study as *high topping*. Plants topped four leaves lower are referred to as *low topping*.

Suckering. Shortly after topping, under favorable conditions of growth, the axillary shoots, called suckers, begin to grow. Their removal naturally accentuates the effects induced by topping. Plots suckered once were so treated just before harvesting. On tobacco suckered two or more times, the axillary shoots were removed at topping ; about ten days later, and just before harvest.

Replication and size of plots. All yields and sorting records are based on several replications of 1/200 acre plots. The plots of each treatment were in duplicate in 1925; in quadruplicate in 1926; and in triplicate in 1927. All abnormal, stunted and diseased plants were eliminated at the time of harvest. Only plants which were representative of the treatment were included in determining the yield and quality.

Fertilizers. The plots had a uniform treatment of a standard tobacco fertilizer at the rate of two tons of a 5–4–5 mixture.

Transplanting and harvest. All plots were set on the same day to insure uniformity in starting. Growth was uniform on all of the plots until the bud stage was reached. The differences in yield and quality, therefore, were a direct effect of topping and suckering treatments. All plots were harvested at the same time and cured in the same shed to insure like treatment after harvest. Since the tobacco was uniform in size, maturity and vigor of growth, on all of the plots at the time the bud stage was reached, important trends on the effects of topping and suckering are indicated in the results obtained.

Special Methods.

Stripping. Instead of stripping the tobacco in the ordinary manner by which all the leaves are mixed together, the leaves from different portions of the plant were kept separate. The upper six leaves in high topping and the upper two leaves in low topping were called "*tops*". The next four leaves were called "*upper leaves*"; the next four were designated as "*middle leaves*"; and the remaining leaves at the bottom of the plant (three to five leaves) constituted the "*lower leaves*." In using this method the effects of the different topping treatments could be traced to specific portions of the plant.

Sorting. The tobacco from these several treatments and plant regions was carefully sorted into the various commercial grades, which were immediately weighed and the results computed on a percentage basis. Also, from the total weight of tobacco from each plot the acre yields were determined.

Experimental Results.

STAGE OF TOPPING.

Yield. As previously mentioned, the treatments were in duplicate, quadruplicate, and triplicate for the years 1925, 1926, and 1927, respectively. These results are presented in Table 1.

Table 1. Yields of Plots Topped at Different Stages of Growth, 1925-1927.

Stage of topping	Average of yield per acre of cured leaf. 1925	1926	1927	3 year average
Bud	1638	1398	1148	1395
Early bloom	1800	1478	1192	1490
Full bloom	1710	1476	1182	1456
Seed pod	1512	1322	900	1245

These results indicate that the early bloom period is the best time to top Havana seed tobacco. The results are particularly pronounced in a favorable year. When the season is exceptionally dry (as in 1926) or exceptionally wet (as in 1927) the difference between early bloom and full bloom is not significant. Abnormal years like these tend to smooth out quantity of growth differences, due to treatment, because the seasonal conditions are the limiting factors. In general, it may be said that an early blossom stage of topping gives better yields than when this is done at too immature or succulent stage or at too woody or ripe stage. If topping is done when the plant is too young growth is checked to such an extent that its adverse effect is reflected in the yield. If topped too late, after seed production has progressed to a considerable degree, topping will have less effect in activating the plant to further vegetative growth. One should not top the plant when it is too immature and succulent, not wait until it becomes old and woody

Quality. The effects of stage of topping on the quality as determined by sorting records is computed to a single figure called the *grade index* and presented in Table 2. The grade index is a single

Table 2. Grade Index of Tobacco Topped at Different Stages, 1925-1927.

Year	Average grade index of tobacco topped at different stages. Bud	Early bloom	Full bloom	Seed pod
1925	.393	.451	.409	.326
1926	.483	.489	.469	.437
1927	.471	.459	.432	.226
3 year average	.449	.466	.437	.330

number, expressing the quality of a particular lot of tobacco. It is based on the percentage of carefully assorted grades and the relative price values. Although market prices for grades vary

from year to year the relative ratio of prices remains fairly constant. The price relationship as used in these experiments is as follows: Light wrappers, 1.00; mediums .75; seconds .50; darks .30; fillers and brokes .10. The grade index is obtained by multiplying the percentage of each grade by the prices indicated above and adding the products.

These results show that the early blossom stage is the best time to top Havana seed tobacco when quality is desired. It is decidedly better than topping at more mature stages.

There are other substantial reasons for topping the tobacco at an early bloom stage. It is desirable to do so early in order to reduce the hazard of winds blowing the crop down. Winds may do serious damage at this time. However, if the plants are topped before the tops become too large they are less liable to be damaged. Also, at this early stage the tops are easily broken because the stems are still succulent. If topped earlier the tops do not develop sufficiently to indicate the proper place to top. Hence, for these additional reasons, it seems better to top tobacco when it begins to blossom rather than at the bud or full bloom stages.

HEIGHT OF TOPPING

Yield. The height of topping does not have as much influence on the yields as one might anticipate. The results in 1925 did not give any decrease in yield due to low topping, but on the contrary an increase. The low topping yielded 1,850 pounds; high topping 1,810 pounds per acre.

The average results for 1926 and 1927 are given in Table 3.

TABLE 3. EFFECTS OF HEIGHT OF TOPPING AT VARIOUS STAGES ON THE YIELDS, 1926-1927.

		Yield per acre (lbs.) at different topping stages.		
Height of topping	Year	Bud	Early bloom	Full bloom
Low	1926	1412	1467	1462
	1927	1145	1172	1192
	Average	1278	1319	1327
High	1926	1385	1490	1462
	1927	1148	1192	1182
	Average	1266	1341	1322

Within the limits of these experiments, the height of topping did not affect the yields. When the tobacco was topped low the remaining leaves increased in size and weight to counterbalance the loss incurred at topping. It is conceivable, however, that still lower topping might reduce the yield. Four leaves below the spike sucker apparently is as low as a plant can be topped without causing a loss in yield.

Quality. Low topping had a marked beneficial effect on the quality. The effect of height of topping on the percentage of lights, mediums and darks is given in Table 4.

TABLE 4. SHOWING THE EFFECTS OF HEIGHT OF TOPPING IN EARLY BLOOM ON THE PERCENTAGE OF DARKS, MEDIUMS AND LIGHTS FOR THREE YEARS, 1925-1927.

Height of topping	% Light				% Mediums				% Darks			
	1925	1926	1927	Ave.	1925	1926	1927	Ave.	1925	1926	1927	Ave.
Seed pod (high)...	0	4	0	1	0	0	1	0	37	28	32	32
High.....	15	15	9	13	13	11	4	9	39	26	31	32
Low.....	23	31	20	25	16	18	11	15	32	18	28	26

Nearly twice as high a percentage of lights and mediums was produced by low topping as by high topping. The tobacco when allowed to go to seed without topping, until the day of harvest, resulted in very poor quality. Chemical conditions within the plant brought about by seed formation are not correlated with high quality leaf. High topping does not counteract this as effectively as low topping. The percentages of lights and mediums is practically midway between those of low topping and those resulting from the normal development of the plant. Severe pruning, i.e., low topping, in an early bloom stage produces high quality tobacco.

Grade index. The simplest way of indicating the relative qualities is probably by expressing it in terms of the grade index. These averages are presented in Table 5.

TABLE 5. SHOWING EFFECTS OF HEIGHT AND STAGE OF TOPPING ON THE QUALITY AS REPRESENTED BY THE GRADE INDEX, 1926-1927.

Stage of topping	Year	Average grade index in relation to height and stage of topping: Low	High	Not topped
Bud.....	1926	.524	.442	.437
	1927	.514	.439	.276
	Average	.517	.440	.331
Early bloom.....	1926	.523	.455	.437
	1927	.524	.395	.276
	Average	.523	.425	.331
Full bloom.....	1926	.491	.447	.437
	1927	.497	.368	.276
	Average	.494	.407	.331
General average.....		.512	.426	.331

The best quality tobacco was produced by low topping in the early bloom stage. This tobacco averaged 8.6 cents more a pound than high topped tobacco for the two years, 1925 and 1926. In every instance the tobacco excelled the corresponding plots topped high. The evidence is conclusive that low topping of Havana seed tobacco results in better quality than high topping.

Regional distribution of grades. Since the quality is improved to such an extent by low topping, it is of interest to note the particular portions of the plant affected. In table 6, the percentage of lights, mediums and darks, produced at different levels on the plant is given.

TABLE 6. SHOWING THE EFFECTS OF HEIGHT OF TOPPING ON THE PERCENTAGE OF DARKS, MEDIUMS AND LIGHTS AT DIFFERENT LEVELS OF THE PLANT, 1925-1927.

		Tops		Upper leaves		Middle leaves		Lower leaves	
Grade	Year	Low	High	Low	High	Low	High	Low	High
		%	%	%	%	%	%	%	%
Darks	1925	84	93	10	23	0	0	0	0
	1926	66	82	11	5	0	0	0	0
	1927	100	100	55	51	0	0	0	0
Average		83	92	25	26	0	0	0	0
Mediums	1925	16	7	3	31	0	5	0	0
	1926	27	8	38	13	0	38	0	0
	1927	0	0	27	12	4	0	0	0
Average		14	5	23	18	1	14	0	0
Lights	1925	0	0	36	25	54	40	5	4
	1926	3	4	42	36	60	16	17	5
	1927	0	0	7	5	51	14	12	0
Average		1	1	28	22	55	23	11	3

There seem to be two opposing tendencies in the plant: first, a decreasing tendency to produce darks extending from the top of the plant toward the base; second, an increasing tendency to produce lights as the lower leaves are approached. There is evidently a point along the stalk where the tendency to produce darks is equal to that of producing lights. This point is higher up on plants that are topped low. Accordingly, the tendency to produce the less desirable darks does not extend as low down on the plant when the plant is topped low. This is indicated by the lower percentage of mediums found in middle leaves under low topping, 1% compared with 14%. The difference between the percentage of darks and lights in the different regions under the two methods is consistently in favor of the lower topping. The tendency to produce inferior quality is consistently associated with high topping, particularly in the middle portion of the plant.

Grade index. To further illustrate the effects of topping on the quality of tobacco in different regions of the plant, comparisons of the grade index are given for two years 1926 and 1927. These results are given in Table 7.

TABLE 7. SHOWING EFFECTS OF HEIGHT OF TOPPING ON THE GRADE INDEX IN DIFFERENT REGIONS OF THE PLANT WHEN TOBACCO IS TOPPED AT DIFFERENT STAGES OF GROWTH.

Stage of topping	Height of topping	Grade index in different plant regions (1926-1927) Upper 1926	Upper 1927	Upper Ave.	Middle 1926	Middle 1927	Middle Ave.	Lower 1926	Lower 1927	Lower Ave.
Bud	Low	.651	.487	.569	.829	.806	.817	.498	.333	.415
	High	.664	.463	.564	.672	.646	.659	.408	.290	.349
Early bloom.	Low	.717	.508	.613	.900	.756	.828	.546	.382	.464
	High	.659	.479	.569	.672	.614	.643	.418	.305	.362
Full bloom	Low	.753	.455	.604	.776	.740	.758	.494	.351	.423
	High	.801	.507	.654	.649	.547	.598	.453	.218	.336
Seed pod		.587	.421	.502	.630	.437	.534	.450	.221	.336
Average	Low	..	..	.595	..	...	801	...	..	.434
Average*	High	...	...	.596	...	...	.633	...	...	.349
Average not topped		...	...	.501	...	...	534	...	...	.336

*Not including seed pod plots.

Tobacco topped later than the early bloom stage rapidly deteriorates in quality. The middle and lower leaves are affected to a greater extent than any other portion of the plant. This undesirable effect is characterized by an overripe condition of these leaves which is associated with yellow, variegated, and mottled colors, when the tobacco is cured

It will be noted in Table 8 that the quality of the middle and lower leaves of the plant is improved the most by low topping. It has been observed that this is the region immediatetly below the maximum sucker development.

TABLE 8. AVERAGE RELATIVE QUALITY ON BASIS OF 100 IN DIFFERENT PLANT REGIONS AS EFFECTED BY TOPPING.

Topping treatment	Relative quality, index in different portions of the plant (1926-1927) Upper leaves	Middle leaves	Lower leaves
Seed pods†	100.0	100.0	100.0
High topping	118.7	118.5	100.4
Low topping	118.7	150.0	129.1

†Not topped until harvest.

High and low topping improved the upper leaves 18.7%, but the middle leaves were improved 50%, by low topping and only 18.5% by high topping. The lower leaves were improved 29.1% by low topping. High topping had practically no effect, only .4%, on the bottom leaves.

Burn tests. The fire holding capacity of the unfermented leaves as affected by the height of topping, was tested by counting the number of seconds a leaf continued to glow after it had been

ignited by an electric match. To facilitate this work a metronome was standardized so that there were exactly sixty beats a minute. Each figure recorded was the average of a burn test on each side of at least twenty leaves taken at random from the grades represented. These burn tests indicated that low topping improved burn. The average burn of darks was 6.2 seconds for high and 9.0 seconds for low topping. The medium averaged 10.7 seconds for high topping and 11.7 for low topping. This difference between the lights was not great. Low topping averaged 13.9 and high 13.4 seconds. There also was a consistent relationship between the duration of burn and the portion of the plant from which the leaves were taken. The tobacco became progressively poorer in burn as the top of the plant was approached. The top, upper, and middle leaves averaged 7.5, 11.5, 13.2 seconds respectively.

These figures indicate that the burn of tobacco is intimately associated with the chemical transformations taking place in the plant after the plant is topped. It also shows the farmer has some degree of control over these changes by the manner of topping.

Low topping of Havana seed not only increases the percentage of desirable grades but also results in an improved burn.

DEGREE OF SUCKERING

Yield. The degree of suckering exerts a marked influence on yield. These results for 1925 are given in Table 9. The plots suckered once were so treated the day before harvest. Those plots suckered twice had an earlier suckering two weeks before harvest.

TABLE 9. YIELDS OF TOBACCO AS AFFECTED BY NUMBER OF TIMES CROP WAS SUCKERED, 1925.

Stage of topping	Yields per acre (lbs.) Suckered once	Suckered twice	% increase from two suckerings
Budded*	1377	1674	21.6
Bud	1530	1746	13.5
Early bloom	1746	1854	6.2
Full Bloom	1674	1746	.3
Average	1582	1755	41.4

*Topped to desired height ten days after the buds were removed.

In 1926, three suckerings in early bloom averaged 1592 pounds per acre as compared with 1,412 pounds when suckered only once.

In all of these trials two or more suckerings consistently yield higher than a single suckering. The average increase per acre was 173 pounds in 1925 and 180 pounds in 1926. These differences are more striking when tobacco is topped in the immature bud stage. This relation is made clear by comparing the percentage increase of the yields resulting from more than one suckering. The average

increase for the bud stages was 17.5% while the more mature blossom stages averaged only 5.2%.

Quality. As previously noted, the yields of the three earliest topping stages were affected more by the number of suckerings than the later stages. These three stages are used to show comparative effects on quality. The percentage of assorted grades from these treatments is given in Table 10.

TABLE 10. PERCENTAGE OF DARKS, MEDIUMS, LIGHTS AND SECONDS ON PLOTS SUCKERED TWICE AS COMPARED WITH THOSE SUCKERED ONCE, 1925.

Number times suckered	Stage of topping	Percentage of indicated grades. Darks	Mediums	Lights	Seconds
Once	Budded	25	3	5	39
	Bud	25	4	4	35
	E. bloom	32	10	15	37
	Average	27.3	5.7	8.0	37.0
Twice	Budded	37	7	7	27
	Bud	37	8	11	26
	E. bloom	38	10	9	26
	Average	37.3	8.3	9.0	26.3

These data indicate that if the sucker growths on tobacco are removed too diligently, there is a resultant tendency to produce high percentages of heavy dark tobacco. The growth of suckers appear to be a desirable characteristic in the production of light colored, free burning tobacco. These actively growing suckers are instrumental in drawing from the leaf materials which are detrimental to quality. These translocation phenomena are intimately associated with the removal of nitrogenous compounds, whose presence in the leaf is associated with dark colors and poor burn. Considering the tobacco taken from any particular plant, high quality is always correlated with a reduction in the amount of these nitrogenous constituents. These changes are most active during the ripening period between early topping and harvest.

SUMMARY

With a given fertilizer treatment, the quality of leaf for any particular season is largely determined by the extent of the changes occurring in the plant between the bud and the harvest stages. The grower can control these changes by judicious topping and suckering.

The best topping stage for Havana seed tobacco is when it begins to blossom. If it is topped at too mature a period of growth the quality deteriorates as evidenced by increased percentages of mottled, yellow-spotted and variegated colors. This over-maturity effect may be avoided by earlier harvest.

Low topping does not necessarily reduce the yield. The remaining leaves grow larger.

High topping increases the percentage of short, low-priced darks. Furthermore, it promotes the production of dark tobacco in regions nearer the base of the plant than is the case with low topping.

Low topping (three to four leaves below the "spike" sucker) consistently gives better quality than high topping (at "spike" sucker).

Low topping stimulates the growth of the lower nine to eleven leaves.

Low topping has a marked beneficial effect on the burn.

There is a regional distribution of grades. The tendency of the plant is to produce darks and mediums in the upper leaves, and lights and seconds in the lower portion of the plant. The lower nine to eleven leaves usually include the bulk of high quality tobacco.

Several suckerings tend toward higher yields but a heavier, darker leaf.

Abundant growth of suckers suggests the removal from the leaf of substances deleterious to quality.

Topping retards the process of seed formation and activates the plant to vegetative growth.

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Connecticut Agricultural Experiment Station
New Haven, Connecticut

REPORT OF THE DIRECTOR

FOR THE

YEAR ENDING OCTOBER 31

1928

The Bulletins of this Station are mailed free to citizens of Connectiout who apply for them, and to other applicants as far as the editions permit.

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

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October 31, 1928

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Report of the Director

For the Year Ending October 31, 1928

To the Board of Control of the Connecticut Agricultural Experiment Station;

In accordance with the usual custom, I have the honor to submit herewith a statement regarding the work of the Station for the past twelve months, together with other information of a pertinent nature. Our Station, the first to be established in this country, has now completed fifty-three years of service to Connecticut agriculture. With this in mind, the following note on its history and record may be appropriate.

The agricultural experiment station had its origin in Europe, the first having been established at Mockern, Germany, in 1851. By 1873 there were sixty-three such stations in continental Europe supported by agricultural societies or by the states in which they were located. The first privately endowed station was established at Rothamsted, England.

In 1853, Samuel W. Johnson, a young graduate of Yale University went to Germany to study chemistry, particularly its application to agriculture. While there he visited several of the experiment stations and studied under some of the famous agricultural chemists of that day. Returning to Yale as an instructor in chemistry, he was appointed Chemist to the State Agricultural Society. During the next twenty years he never ceased to urge in his lectures and in the press, the need of agricultural stations in this country, and as a result of his labors, the Legislature of 1875 secured to Connecticut the honor of establishing the first agricultural experiment station in America. Connecticut having pioneered in the movement, several other states followed, until in 1887 Congress passed the Hatch Act, providing for a station in each state.

The duties of the Station as defined in the statute are three-fold: the analysis of fertilizers, feeds, drugs, foods and other products for the protection of the people of the State; the conduct of "scientific investigation and experiments" in agriculture and related sciences; the dissemination of the results.

As an example of the first, the fertilizer inspection of 1928 disclosed the sale of a brand of fish meal to which had been added sulfate of ammonia, thus causing a low grade fish to show the same amount of total nitrogen as does the high grade product. These facts were made known immediately and the purchasers have been reimbursed by the dealers who unwittingly sold the goods.

Other direct services include the inspection of nurseries and orchards, the control of insect pests and plant diseases, the dis-

tribution of forest planting stock, the testing of seeds, advice on the management of land and the like.

Under the head of "experiments" might be listed a long series of investigations covering the fifty-three years of the Station's existence. Notable among them are those dealing with corn breeding, the white pine blister rust, the chestnut bark disease, tobacco wild fire, tobacco root rot, the nature of the vegetable proteins, the discovery of the vitamines and studies on the food value of milk. For this last it is fair to say that most of our recent knowledge of the food value of milk and the resulting increase in its consumption are traceable to the contributions of the Station.

The dissemination of results is accomplished through bulletins, lectures, the work of the Extension Service, correspondence and many personal visits to farms and orchards. The Station is not only a research institution—it is and always has been a service agency for the people of the State. The following quotation from the Report for 1902 truly describes the policy that the Station has always tried to follow: "It is the wish of the Board of Control to make the Station as useful as its resources will admit. Every Connecticut citizen who is concerned in agriculture, whether farmer or resident of a city, has the right to apply to the Station for any assistance that comes within its province to render, and the Station will respond as far as lies in its power."

REVIEW OF THE YEAR

The Station has been unusually fortunate in the number of outstanding scientists who have been members of its staff since its establishment. Among those deserving highest honor is Dr. Thomas B. Osborne, who at his own request has been relieved of active charge of the Biochemical Laboratory and given the title of Consulting Biochemist. Coming to the Station in 1886, Dr. Osborne soon began his life work, the study of the Nature of the Vegetable Proteins, for which his name is known and honored throughout the scientific world. In collaboration with Dr. Lafayette B. Mendel of Yale University, he has pioneered in the newer phases of nutrition, thus adding to the reputation of the Station for fundamental contributions to agriculture and science. It is a source of satisfaction to all interested in the Station to know that Dr. Osborne is to maintain his active interest in the work he established and carried on so well and that we will continue to have the benefit of his advice and counsel.

The annual reports of the Station now number fifty-two and constitute a record of unusual value. Included in each report is an index but a cumulative index has never been prepared except for two subjects, Entomology and Food and Drugs. Dr. Jenkins volunteered to undertake this task and a complete index of all

matters of permanent value is now ready for the printer. With this will be included several special sections such as Analyses of Unusual Fertilizer Materials, A Complete List of Members of the Staff, and the like. Not only the Station but all those having occasion to consult agricultural literature will be indebted to Dr. Jenkins.

FIGURE 2. Analyzing Foods and Drugs—Analytical Laboratory.

CONTROL AND SERVICE WORK

INSPECTION OF FERTILIZERS, FEEDS, FOODS, DRUGS, ETC.

In accordance with the statutes relating thereto, the Analytical Laboratory has analyzed 900 samples of *Fertilizers and Fertilizer materials*. Of these, 536 were drawn officially by the Station Agent and the balance were received from farmers. The Report

on Fertilizers will appear in December, 1928, as Bulletin 296 of the Annual Report of the Station.

The *Feed Inspection* has involved the analysis of 800 samples, the report on which will be printed early in 1929. Over 800 brands of feeding stuffs are now registered for sale in Connecticut.

The examination of *Foods and Drugs* occupies a considerable portion of the time of the laboratory. During the past year 1,288 samples were analyzed, including such a wide variety of foods as pickles, sweet chocolate, breads and ice cream; and of drugs, powdered pepsin, Fowler's solution and many proprietary preparations. Special studies were made of cod liver oils (for vitamine A) and of "denicotinized" tobaccos, the latter especially attracting wide attention among physicians and laymen.

Of *Babcock Glassware*, 2,540 separate pieces have been calibrated and 134 dairy thermometers standardized, in accordance with the statutes.

In addition to the above regular duties, a large amount of detailed analytical work has been done in collaboration with the Tobacco Substation at Windsor, the Storrs Experiment Station and the Association of Official Agricultural Chemists.

CONTROL OF INSECT PESTS

The constantly increasing number of insect pests, the establishment and enforcement of quarantines, together with the necessary inspections and scouting, require more attention each successive year.

The State quarantine on account of the *Asiatic Beetle* has been maintained and enforced, and 426 certificates have been issued covering 2,951 cubic yards of soil and for 4,394 plants to be moved out of the restricted area. About 1,194 plants have been inspected by one of the staff, who has also examined 55 lawns by request and shown the owners how to apply the lead arsenate treatment. No carbon disulphide emulsion was applied in 1928.

The *Japanese Beetle* has been the subject of much attention. In 1927, the beetles were discovered in rather large numbers in Bridgeport, and on December 1, 1927, the quarantine was extended to cover two rows of shore towns from the New York line to the Housatonic River, in conformity with the Federal quarantine. From June 15 to October 1, all principal highways leading out of the quarantined area were patrolled during the day time, and a 24-hour patrol service was maintained at the eastern end of the Washington Bridge on the Boston-New York Post Road, to prevent the movement of farm products out of the quarantined area except in conformity with the regulations. An inspection stand was established in Bridgeport to facilitate the inspection of truck loads of produce to be shipped out of the area.

During the summer of 1928, Federal men scouted for the beetles in nearly all cities and larger towns of Connecticut outside the quarantined area, resulting in the discovery of infestations in New Haven, New London and Hartford. Only a few beetles were found at each of the first two places but the Hartford infestation was larger and the number of beetles probably ran into the hundreds. At Springfield, Mass., not far from the Connecticut line an infestation was found containing nearly 5,000 beetles. As yet there has been no Federal action regarding quarantines but it is probable that the present quarantine will be extended to include New Haven and adjacent towns, and that the other colonies will be treated as "outside" infestations. This work is conducted in

FIGURE 3. Burning Corn Stalks and Stubble in Stonington—European Corn Borer Control.

co-operation with the Federal Plant Quarantine and Control Administration.

The *European Corn Borer* has spread markedly during the season. Clean-up measures around the 1927 infestations were conducted partly in the fall and completed the following spring by State and Federal forces working in co-operation. In 1928, 21 new towns were found to be infested. These with the five already under quarantine make 27 towns in which the Corn Borer was found in 1928. A continuation of the clean-up methods practiced in the past seems to be out of the question on account of the expense and legislation compelling the owners or tenants to dispose of their corn stalks is now being considered.

There has been no important spread of the *Gipsy Moth* in Connecticut during the season. No stripping has occurred within the

State but larger areas than ever before were defoliated in Massachusetts, New Hampshire and Maine.

The annual *Inspection of Nurseries* has been conducted with greater care and thoroughness than ever before on account of the new pests to be looked for. The Station has also inspected the fruit and rose stocks imported from foreign countries into Connecticut nurseries for propagation.

The work of *Mosquito Elimination* has been continued as usual. Considerable new ditching work has been done during the year with funds raised by town appropriations and private contributions. The ditching in Hamden, East Haven and Old Saybrook

FIGURE 4. A New Double-width Ditch at Hammonasset Park—Mosquito Elimination.

is not completed, but funds will be provided. The City of New Haven has installed a new tide gate at the Little River bridge on Middletown Avenue, which will make possible the ditching of a considerable area in North Haven. All of this work means a greater cost for maintenance, for according to the law the State is morally, if not legally responsible for maintenance after the areas have been properly ditched and the work approved and accepted. The appropriation for this work must be increased if the Station is to carry out the provisions of the statute.

WHITE PINE BLISTER RUST

During the past season 123,385 wild Ribes and 1,151 cultivated Ribes were destroyed on 75,102 acres. The work was conducted in 26 towns. Approximately one and a half percent of the acreage

covered this year was a re-eradication of areas worked in previous years. 245,045 acres of non-pine land in the general pine region were eliminated from control.

The nursery sanitation project undertaken in 1927 was extended to include 3,962 acres surrounding commercial nurseries and 1,480 acres of water company plantings. These figures are included in the 75,102 acres reported above.

SUMMARY OF WHITE PINE BLISTER RUST CONTROL—1925 to 1928

Year.	Initial Erad. A.	Re-Erad. Acres.	Tot. A. Erad.	Wild Ribes	Cult. Ribes.	Estimated Pine A. Protected.	Nursery Sanitation Acres.
1925	6,688	40	6,728	258,515	684		0
1926	21,687	570	22,256	182,826	330	7,400	0
1927	12,068	8,836	20,904	159,121	2,235	10,400	1,000
1928	68,539	1,122	69,661	123,383	1,151	34,800	3,962

All eradication in 1927 and 1928 represents co-operative effort on the part of towns, individuals, pine owners, and the state. There is a noticeable reduction in the number of wild Ribes destroyed each year which indicates that initial eradication is effective in the areas of heaviest Ribes concentration. Blister Rust has been arrested on protected areas, but some re-eradication will be necessary each year if previously eradicated areas are to be kept in a sanitary condition.

SEED TESTING

This year a special study was made of the quality of Flower Seed offered on the Connecticut market and the inspection of Vegetable Seed was continued. The following table shows the extent of this work:

Kinds.	Number of samples.	Number of varieties.	Number of strains.
Vegetables	190	25	71
Flowers	62	26	14
Field Crops	33	14	18
Trees	20	8	5

SPRAY SERVICE

In continuation of the plan developed some years ago, the Station collaborated with the Extension Service and the Pomological Society in a Spray Service for orchardists. Two members of the Staff visited orchards regularly during the spring and summer, thus keeping in close touch with the appearance and development of insect pests and fungus diseases. The data collected, together with the weather predictions, provided the basis of advice on spraying and dusting.

DISTRIBUTION OF PLANTING STOCK

One and a quarter million trees were distributed during the past year for forest planting purposes, 333,000 of these going to farmers under the Clark-McNary Act. This is almost twice the number distributed in 1927.

Progress of Investigations

Here follow brief notes on those projects of greatest interest or on which definite results have been obtained during the year. No attempt is made to discuss all of the investigations under way, a list of which will be found on page 134.

BIOCHEMISTRY

Chemistry of the Proteins. As a part of the study of the methods for the separation of the basic amino-acids of proteins, highly purified crystalline samples of several of these substances have been prepared and photomicrographs published. A crystalline preparation of lysine had not been obtained previously.

Convenient methods for the preparation of both arginine and histidine on a large scale have also been developed. Analyses of the basic amino-acids of two proteins, edestin and oxyhemoglobin have been made and a full review of current speculations upon the constitution of proteins has been published in Physiological Reviews. Papers describing the other phases of the work have been published in the Journal of Biological Chemistry.

Nitrogenous Constituents of Plants. Progress has been made in the investigation of the simpler nitrogenous constituents of fresh green tobacco leaf although no papers have as yet been published. This work is being actively continued.

Experiments in Nutrition. Extensive data have been collected on the effect of diets deficient in various respects upon growth and the composition of the bones. A method has been developed for modifying the determining factors, one at a time. Thus the influence of the fat-soluble vitamine, the proportions of the inorganic nutrients and the potential reaction of the diet is being investigated.

In connection with extended earlier observations on the influence of green leaves on nutrition the potency of watercress with respect to some of its constituent vitamines has been investigated. This substance is found to be comparatively rich in vitamine A. The content of vitamine "B" in liver and preparations thereof is also being studied anew.

BOTANY

Mosaic. The rogueing experiment for the control of mosaic in Cuthbert Raspberries, in co-operation with the U. S. Bureau of Plant Industry has been continued. Because of unusual spread

in 1927, many plants were removed. Plot I, consisting of plants received from Massachusetts, still shows the greatest amount of mosaic, although the disease is now general in all of the five plots.

FIGURE 5. Weighing White Rats in the Nutrition Laboratory.

The practicability of this method of control has not yet been demonstrated by this experiment.

Infection of tobacco plants with "white-pickle" mosaic of cucumber produced some leaf mottling, but failed to produce plate

crystals in these mottled leaves and also seemed to disappear in the new growth. Last year somewhat similar results occurred with infection of cucurbits with "white-pickle" that seemed more or less temporary.

Plant Disease Survey. Because of the very wet summer the year has been unusually favorable for the development of plant diseases. As a result we have secured a greater number of diseases new to

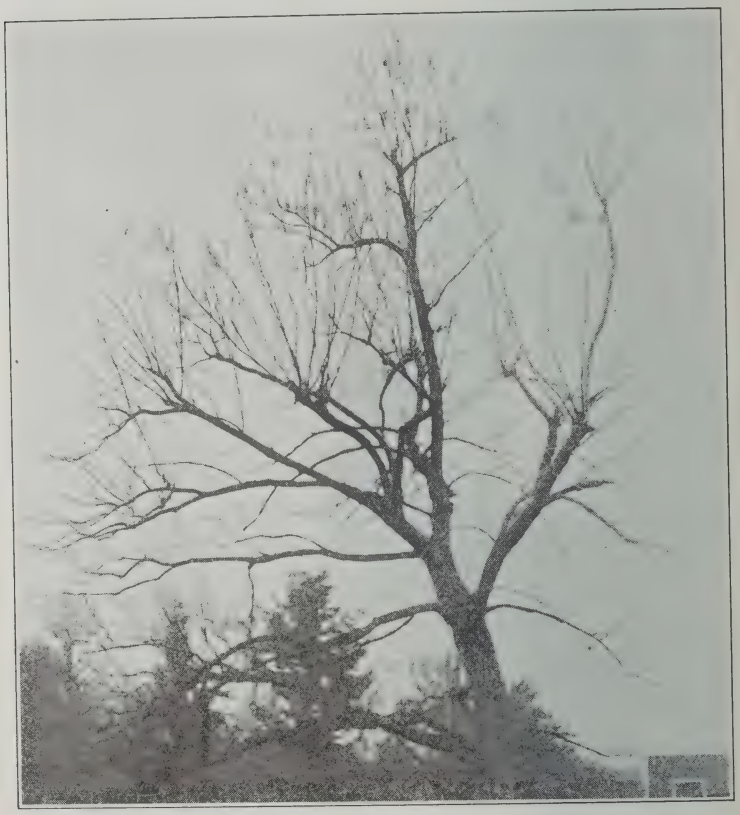

FIGURE 6. A Tree Practically Defoliated by Willow Scab.

the state than for sometime. Among the more important of these are bacterial leaf diseases of corn and horse radish, a Fusicladium disease of poplar similar to the new willow disease of last year, several Helminthosporium diseases of grains and grasses, a fungous leaf-scorch of maple, the Macrosporium blight of carrots, a Phytophthora rot of tomato fruit, and a number of new hosts for the Sclerotium stem-rot of herbaceous perennials. Besides these,

potato blight made its earliest recorded appearance in the state and caused some damage to the vines and rot of the tubers. The Fusicladium scab continued its destruction of willows, being even worse than last year.

Chestnut Blight. Last spring about 1,300 one-year-old chestnut seedlings were planted in two new places, Southport and Redding Ridge. This makes four locations in the State on which over 2,500 seedlings have been set out in recent years to see whether they would survive the blight. So far considerably more than half of the seedlings have died from unfavorable environment but none from blight. It seems to be difficult to carry the seedlings through the first season, especially when set out in the sun. This year's plantings, however, have apparently done better than usual due to the wet summer. A quantity of this year's nuts has been secured from the South for starting more seedlings. Records have also been made of two marked plots of native seedlings and sprouts in the woods to determine the progress of the blight from year to year.

Tree Diseases. The most important and extensive work in this field has been the new willow scab or blightfungus, *Fusicladium saliciperdum.* Considerable time has been spent in determining the distribution of this fungus, especially in this state and Canada, in noting its damage and the species of willows attacked. Cultures of the fungus were obtained and successful inoculations made in producing the disease similar to that in nature. Successful spraying experiments have also been carried on for its control.

ENTOMOLOGY

Asiatic Beetle. The investigations on the life history, habits and methods of control of the Asiatic beetle, *Anomala orientalis*, are completed and the data has been assembled, analyzed and prepared for publication. During 1928 much attention has been given to control by applications of lead arsenate, both mixed with the top layer of soil before seeding, and washed into the turf where re-seeding was unnecessary.

Plum Curculio. The six year study of the control of this insect in Connecticut apple orchards has been completed and the data is now nearly ready for publication. It was found that four applications of lead arsenate, preferably the pink, calyx, 7-day and 2-weeks sprays will give fair control.

Oriental Peach Moth. No satisfactory method of artificial control has yet been discovered. During the year, the ichneumonid parasite *Glypta rufiscutellaris*, was reared for the first time in considerable numbers in Connecticut from the Oriental fruit moth, and it was more abundant than the other ichneumonid parasite, *Macrocentrus ancylivora*, which has heretofore been the principal parasite of the Oriental fruit moth in the state. The egg parasite, *Trichogramma minuta*, was also present in 1928. Nearly 2,500

larvae of the Oriental fruit moth have been collected and reared for the experimental work of 1929. Over 600 of these were obtained from a bushel of quinces grown in Cheshire.

FORESTRY

Treatment to Prolong the Life of Timber. In co-operation with the Tobacco Substation at Windsor, the Forestry Department has undertaken to demonstrate the value of preservative treatment for tobacco shade-tent poles and the relative value of various native woods so treated, compared with chestnut. Posts of all the species common in Connecticut were peeled and seasoned last fall. In the spring they were treated with creosote and set in rows

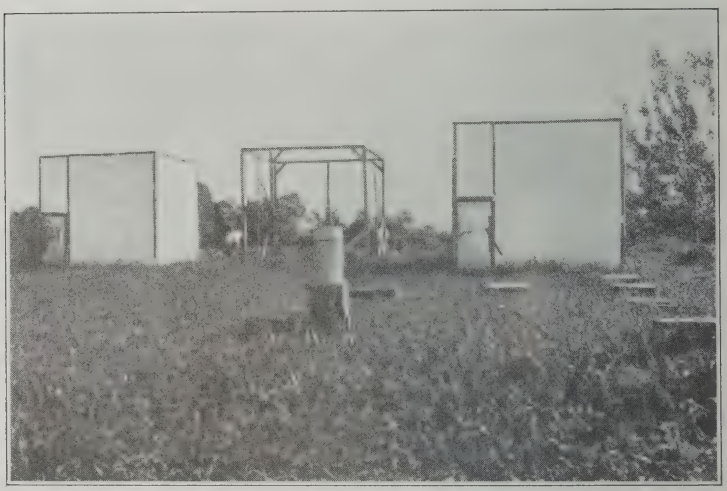

FIGURE 7. Tree Cages at Mt. Carmel Farm Used in Studying the Oriental Peach Moth.

on the Tobacco Station farm. Untreated check posts were included. Naturally no data will be available for some years.

In the meantime there is a demand for information on methods of treating posts. Tobacco Station Bulletin No. 9 was therefore prepared and distributed last fall. It is a short, illustrated paper describing the methods of treatment adapted to farm use and the results that may be expected therefrom.

The Rainbow Plantations. Begun in 1902, these plantings have reached an age where they are yielding much valuable information. In addition to the comparisons between the several species, pruning and thinning experiments are now possible. Also these plots are furnishing an excellent opportunity for studying the effects of pure and mixed stands on the soil conditions which determine rate of growth.

A minor project undertaken during the year in co-operation with the Botany Department, was one to determine the effect of calcium chloride washed from roadways on ornamental Norway spruce trees planted close by. The first results indicate that a solution of more than five percent strength is necessary to seriously damage the trees.

The Relation of Soil Type to Forest Composition and Rate of Growth. The work on this project was continued during the 1928 field season with a study of growth of pine plantations as related to soil type. It was originally planned to carry on the work with both red and white pine, but because of damage done by the weevil to white pine, investigation of this species was temporarily

FIGURE 8. White Pine Plantation after "Cordwood" Thinning.

abandoned and efforts were confined to red pine. Two hundred stations in red pine plantations were established as temporary plots. The data included:

a. The height of ten or more dominant trees.
b. Detailed notes on soil type and other soil factors.

From the tree measurements a "site index curve" for red pine has been prepared and tables derived therefrom. By the use of these tables any plantation or portion thereof may be given an "index number" which denotes the site quality or growing capacity of the land. At an age of fifteen years, the range in height (site index) varied from nine to twenty-two feet. The correlation between soil type and site quality is now being determined.

Using the data taken during the past season it is planned to select some twenty permanent plots where a careful study of soil

conditions will be begun in red pine plantations to ascertain what soil factors are important in determining the growth of this species, and the effect of the forest planting upon the soil.

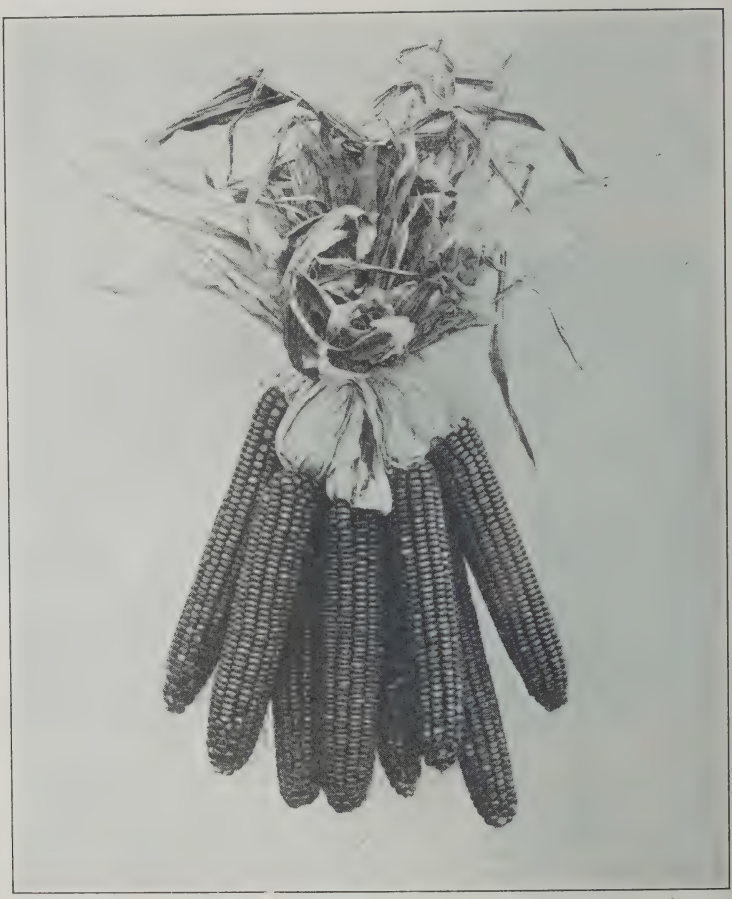

FIGURE 9. Canada Leaming. A new type of Crossed Corn. As early as Canada Flint and as productive as Leaming.

PLANT BREEDING

Corn Breeding. A new type of "crossed" field corn has been distributed for trial. This is a first generation combination of inbred strains of Leaming dent and Canada Yellow Flint and is called Canada Leaming. It unites the high yielding power and stalk growth of the dent type with the early maturity and good grain quality of the flint. This corn is being tested in Southern New

England as a husking corn and in Northern New England for silage purposes.

About 150 crosses of inbred strains of Whipples Early Yellow sweet corn have been grown in a preliminary trial and some combinations have shown outstanding productiveness and uniformity in size and shape of ear and in time of ripening and at the same time have been as early or earlier in maturity than the original variety.

A new variety of sweet corn, not a first generation cross, has been produced by combining a number of inbred strains of Golden Bantam and Crosby. This new variety, which reproduces itself each year, is called Golden Crosby and in preliminary tests has met with favor from some of the Connecticut seedsmen who are growing it for canning purposes.

Abnormal segregation of the sugary factor in certain families of corn has given widely deviating ratios, in most cases a large excess of recessive seeds and in other cases a marked deficiency. The ratios show larger variations from normal than have been found previously and indicate a new mode of inheritance that is not clearly understood.

Vegetable Breeding. Crosby Egyptian beets have been completely self-sterile, no seed having been produced from bagged flowers nor from isolated plants. Breeding methods with this plant will necessarily be limited to open pollinated selections and to sib-matings. The effect of environmental conditions on the color of garden beets is being studied also.

Selections have been made in the second generation of a cross between a late and unproductive straightneck type of summer squash with an early crookneck in an attempt to fix an early straightneck type of good quality.

A new variety of spinach is now in the third generation of selection from a cross of Virginia Savoy, Viroflay and King of Denmark. It combines in a large measure size, earliness and long keeping qualities from its parental types.

A large number of selections from the cross of Alacrity and Earliana tomatoes have been grown in the attempt to produce a strain of the Earliana season, but with better shape and quality of fruit. Some of the selections which are now in the third generation are promising.

A remarkably productive and early-ripening pepper has been developed from a cross of Sweet Spanish by Harris Earliest. Several selections are being put through a careful test and will soon be available for preliminary trial by market gardeners.

SOIL INVESTIGATIONS

The Soils of Connecticut. Detailed investigations of the supply and availability of plant nutrients in the important soil types of the State have been continued. During the 1928 season two crops

of tobacco and one crop of oats have been grown in the greenhouse on twenty-four soils. Tobacco has proven to be an ideal crop to reveal differences in the availability of the several plant nutrients contained in the soil. The most striking results may be summarized as follows:

Twenty-two of the twenty-four soils showed marked deficiency of potash and twenty exhibited more or less pronounced lack of available phosphorus. Results of greenhouse tests can be correlated very closely with the rapid method for the determination of

FIGURE 10. A Field Party Studying Connecticut Soils.

available phosphorus now used in the soils laboratory. None of the soils were able to supply sufficient nitrogen for normal growth of tobacco, although some contained as high as 10,000 pounds of total nitrogen per acre.

Tobacco showed abnormal growth on two very acid soils (3.9-4.0 pH). On these particular soils, this reaction was correlated with abnormally high concentrations of soluble manganese and aluminum. All the other soils, even with pH values as low as 4.6, showed little or no response to lime for the tobacco crop.

Forest Soils. A study of the characteristics of various types of soil under forested conditions is in progress, with a view to determining the soil factors which have a definite relation to silvicultural practice in Connecticut. Most forest soils that have never been farmed have been found to be considerably more acid than ordinary agricultural soils. Several extremely acid (as low as 3.2 pH) forest soils have been encountered. This phase of the program will be more actively followed than heretofore.

Co-operation with the Storrs Station. During the summer of 1928 one hundred and twenty-five farms distributed over the eastern highland of the State have been surveyed as to soil type in co-operation with the Agricultural Economics Department of the Storrs Experiment Station, which is studying the "Economic Significance of Soil Type." Soil maps of each farm were prepared, and samples of soil from over a thousand fields were tested for acidity. Soil samples from sixteen of these farms have been collected and are to be studied intensively in the greenhouse and laboratory.

Lawn Management. Lawn fertilization experiments have been conducted for the past three years. For average lawn turf on soils similar to that at the Station, top dressing with a readily available nitrogeneous fertilizer like sulfate of ammonia has proven to be the most important requirement. Moderate applications of phosphoric acid and potash help to keep up the fertility of the soil, but without a fertilizer containing available nitrogen, they are of little or no benefit.

Seeding trials with various lawn grasses, particularly the bent grasses, are being conducted. Stolon plantings of several strains of creeping bent have been successful, but are not proving thoroughly satisfactory to maintain under average lawn conditions. Seedings of several strains of bent grass produced commercially have demonstrated that native grown seed of creeping bent, velvet bent and Rhode Island bent are well adapted to local conditions where excellent drainage is provided. Fully as good turf has been produced by seeding creeping bent as by planting the stolons.

Connecticut River Flood Plain Studies. At the request of the Attorney General's office the Soils Department has undertaken a special study of the soils of the Connecticut River Flood Plain and the effects of periodic flooding on their productivity. A detailed soil and land cover survey has been completed of over 20,000 acres adjacent to the Connecticut River north of Middletown and laboratory and greenhouse studies are being made of the characteristics of these soils and of the sediments deposited upon them by floods.

TOBACCO SUBSTATION

Relation of Fertilizer Ingredients to the Burn of Tobacco. Sulfate of ammonia has seriously lowered the fire holding capacity of the leaf. Dry ground fish in large quantities has had the same effect

but to a less degree. Urea, tankage and nitrate of soda have had no pronounced effect in either direction. Muriate of potash has been extremely injurious to burn. Double sulfate of potash-magnesia slightly reduced the fire holding capacity when compared with sulfate of potash. Both carbonatate and nitrate of potash gave a better burn than sulfate. Lime produced a very white ash but lowered the fire holding capacity.

The Effect of Various Fertilizers on the Chemical Composition of Tobacco. Different carriers of nitrogen have not changed the total amount of nitrogen absorbed by the plant. The lower leaves of the plant have higher percentages of total ash, potassium, calcium, and nitrate nitrogen than the upper leaves.

The upper leaves have higher percentages of phosphorus, ammonia nitrogen, nicotine and chlorine than the lower leaves.

Plants treated with sulfate of ammonia show increased percentages of manganese, sulfur and aluminum.

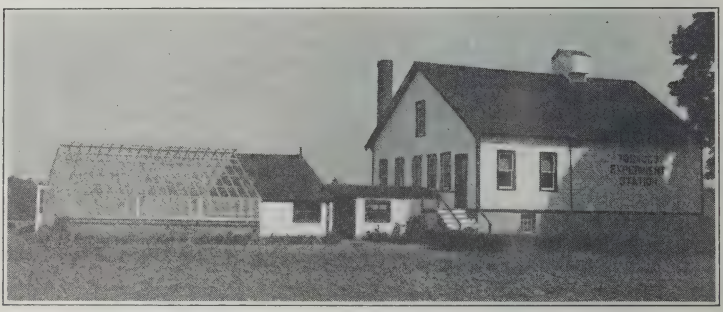

FIGURE 11. Laboratory and Greenhouse at the Tobacco Substation at Windsor.

The potash content of the plant is reduced appreciably by ommitting potash from the fertilizer even though the soil naturally contains a large supply of potash.

Effect of Some Nitrogenous Fertilizers on Soil Reaction. Sulfate of ammonia has had the strongest influence in making soil more acid. Dry ground fish and tankage have had an acidifying tendency but to a less degree. Urea made the soil more acid after the initial alkaline effect had disappeared. Nitrate of soda reduced soil acidity, but nitrate of potash had no pronounced effect.

Urea as a Source of Nitrogen. Results with this fertilizer have been very satisfactory when it was used in moderate amounts. Two other synthetic nitrogen compounds, nitrate of potash and nitrate of lime also have given good results.

Increasing the Organic Matter in the Soil. Manure as a supplement to commercial fertilizer has given somewhat increased yields and better quality on a very sandy soil. A similar effect has been

produced by the use of a commercial "humus" product or by covering the sandy plots with muck soil.

Cover Crops for Tobacco Soils. During wet years on a sandy soil the yield and quality have been increased by the use of certain winter cover crops. Oats, barley and rye have been most effective. Wheat, alfalfa and red top have had a slightly beneficial effect while timothy has been detrimental.

Field Days and Exhibits

The Mt. Carmel Farm Field Day was held on July 18, the New Haven County Farm Bureau joining with the Station in the same

Figure 12. Station Exhibit at the State Fair, 1928.

manner as in 1926. The general topic was Plant Pests. Professor W. H. Whetzel of Cornell University and Professor W. C. O'Kane of New Hampshire University were the speakers.

The Field Day at the Tobacco Substation was unique in that some two hundred tobacco farmers from Pennsylvania spent the afternoon inspecting the plots.

A general Station exhibit was made at the State Fair in Hartford and also a special tobacco exhibit.

Library

During the year there were added to the Station Library 900 accessions of permanent value. Journals purchased now number 50, in addition to which some 30 farm papers and journals are received as exchanges. For a few of the old farm papers we have complete files. The total number of bound volumes is now 16,800.

Physical Equipment

Additions to the Station's scientific equipment include a rotary microtome, an apochromatic objective, an electric warming table for slides, a Berkefeld filter, an electric incubator, a steam pressure sterilzer, a moisture equavalent centrifuge, two analytical balances, a wide field binocular microscope, two experimental tobacco curing chambers with temperature and humidity controls and an electirc computing machine.

An addition to the barn at the Mt. Carmel Farm provides much needed space for the Botany and Entomology departments.

Changes in Staff

Appointments;

Herbert A. Lunt, M.S., Research Assistant in Forest Soils, August, 1928.

George W. Pucher, Ph.D., Research Assistant in Biochemistry, September, 1928.

Mrs. Gladys Brooke, B.A., Secretary in Entomology Department, September, 1928.

Harold B. Bender, B.S., Graduate Assistant in Botany, October, 1928.

Resignations;

H. J. Lutz, M. F., Assistant Forester, June, 1928.

George Zundel, Ph.D., Graduate Assistant in Botany, July,1928.

Grace A. Foote, B. A., Secretary in Entomology Department, August, 1928.

ACTIVE PROJECTS.

Analytical Chemistry.

Dr. E. M. Baily in charge.

1. Inspection of Fertilizers.
2. Inspection of Feeding Stuffs.
3. Inspection of Foods and Drugs.
4. Calibration of Babcock Glassware.
5. Inspection of Insecticides and Fungicides.
7. Analysis of Diabetic Foods.

Biochemistry.

Dr. T. B. Osborne, Consulting Biochemist.

Dr. H. B. Vickery, Biochemist in charge.

(In Collaboration with Dr. L. B. Mendel, Yale University.)

1. Cell Chemistry.
   a. A detailed investigation of the nitrogenous constituents of plant cells including not only the protein components but also the hitherto scantily considered non-protein substances. The methods developed and successfully applied to the green leaf in the case of alfalfa are now being extended to the *tobacco leaf.*
   b. The investigation of the nature of the simpler nitrogenous constituents of yeast.

2. Protein Chemistry.
   a. The methods for the determination of the basic amino acids of proteins are under investigation with the object of effecting improvements.
   b. Methods for the preparation of pure proteins on a large scale with the object of obtaining material for chemical and nutritional study.
3. Nutrition Investigations.
   a. The relation of diet to the rate of growth with especial attention to certain factors which appear to determine rapid growth.
   b. The investigation of the relation of diet to opthalmia.
   c. Experiments on the relation of diet to fertility in cooperation with Dr. Mason of Vanderbilt University.

BOTANY.

Dr. G. P. Clinton in charge.

2. The Nature and Cause of Mosaic Disease of Plants.
3. The Ustilaginales of North America.
4. The Rusts of Connecticut.
5. Plant Disease Survey of Connecticut.
6. Thielavia basicola; a Study of the Perfect Stage.
7. A Study of Pythiums.
8. Spraying and Dusting Experiments on Apples and Peaches. (With Entomology.)
12. Seed Testing.
13. Peach "Yellows."
15. Chestnut Blight—virulence studies.
18. Tobacco Diseases—especially Black and Brown Root Rot. (Experiments at Tobacco Substation.)
20. Tree Diseases.
23. Rogueing as a Control for Raspberry Mosaic. (With U. S. D. A.)

ENTOMOLOGY.

Dr. W. E. Britton in charge.

3. Spraying and Dusting Experiments on Apples and Peaches. (With Botany.)
6. Control of Foul Brood of Bees.
7. A Study of the Asiatic Beetle, *Anomala orientalis.*
9. Insect Survey of Connecticut.
16. Experiments with the Cabbage Maggot.
17. Life History and Methods of Controlling the Oriental Peach Moth, *Laspeyresia molesta.*
18. Life History of Imported Currant Worm.
20. Life History, Habits and Control of the Imported Birch Leaf-Miner, *Fenusa pumila.*
21. Life History and Control of the Spinach Leaf-Miner.
26. Experiments on the Control of Squash Vine Borer.

Control Projects.

10. Inspection of Orchards and Nurseries.
11. Control of Gipsy Moth.
12. Elimination of the Mosquito Nuisance in Salt Marshes.
13. Inspection of Apiaries.
19. Control of the European Corn Borer.
24. Control of the Asiatic Beetle.
25. Control of the Japanese Beetle.

FORESTRY.

Mr. W. O. Filley in charge.

1. Experimental Plantations on a Sandy Tract at Rainbow.
   a. Comparison of a wide variety of conifers and hardwoods.
   b. Methods of management for those species that have survived.
   c. Studies on growth and habits of the several species.
2. Effect of Thinning in White Pine (At Shaker Station)—Three Grades of Thinning.
3. Effect of Thinning in Hardwoods (At Quassipaug Lake).
5. Distribution of Forest Planting Stock. (Under Clark-McNary Act.)
8. Studies of Forest Plantations (State-wide).
   a. Comparative growth of various species.
   b. Reasons for success or failure.
   c. Soil and other site factors necessary for success of each species.
10. An Investigation of the Distribution and Growth of Forest Trees as Influenced by Soil Conditions and Other Site Factors.
11. Coniferous Seed Bed Study to Determine.
    a. The value of fertilizers in seed beds.
    b. The value of different amounts of seed.
    c. The value of dusts and sprays in preventing damping off.

Control Project

7. Control of White Pine Blister Rust. (With U. S. D. A.)

GENETICS (PLANT BREEDING)

Dr. D. F. Jones in charge.

1. A Genetic Study of Hereditary Characters in Corn Involving Their Linkage Relations and Variability, with particular attention to characters directly influencing yield.
2. The Effect of Inbreeding and Crossing upon Corn in Relation to Vigor, Rate of Growth, Productiveness and Variability.
3. Methods for the Improvement of Naturally Cross-Fertilized Plants by Selection in Self-Fertilized Lines, with particular attention to field corn for grain and ensilage, alfalfa, and to some of the more important Vegetable Crops such as sweet corn for market gardening and canning, beets, cabbage, carrots, cucumbers, melons, onions, radish, rutabagas, squash and some Fruits such as bush fruits and strawberries.
4. Methods for the Improvement of Naturally Self-Fertilized Plants, with particular attention to Tobacco and Vegetable Crops such as lettuce, lima beans and tomatoes.

SOILS

Mr. M. F. Morgan in charge.

1. What Soil Characters are Factors in Determining the Agronomic Value or Utilization of Land?
2. Experiments in Lawn Fertilization.

TOBACCO SUB-STATION AT WINDSOR

Dr. P. J. Anderson in charge.

1. Fertilizer Experiments:
   Various Sources and Rates of Nitrogen, Phosphoric Acid and Potash.
2. Experiments with Farm Manure.
3. Experiments with Manure Substitutes.
4. Tobacco Nutrition Studies: the Rôle of Nitrogen, Sulfur, Chlorine, Potassium, Calcium, Manganese, Boron, Magnesium.
5. Improvement of Havana Seed Tobacco.
6. Improvement of Broadleaf Tobacco.
7. Improvement of Cuban Shade Tobacco.
8. The Effect of Various Winter Cover Crops used on Tobacco Land.
9. Brown Root Rot of Tobacco (with U. S. D. A.).
10. Studies on Black Root Rot of Tobacco.
11. Soil Reaction in Relation to Tobacco.
13. Preservative Treatment of Shade Tent Poles.
14. Tests of Wires for Shade Tents.
15. The Effects of Topping and Suckering at Different Heights and Dates.
16. The Effect of Stage of Picking Shade Tobacco.
17. The Rôle of Humidity and Temperature in Curing Tobacco.
19. Tobacco Diseases—Miscellaneous.
20. Tobacco Insects—Miscellaneous.
21. A Study of the Root Development of the Tobacco Plant.

PUBLICATIONS

Bulletins

No. 290. Fertilizer Report for 1927.
No. 291. Report of the Director for 1927.
No. 292. Some Insect Pests of Nursery Stock in Connecticut.
No. 293. The Quality of Vegetable Seed bought by Market Gardeners in Connecticut in 1927.
No. 294. Report of the State Entomologist for 1927.
No. 295. Report on Foods and Drugs for 1927.

TOBACCO SERIES

No. 9. Prolonging the Life of Tobacco Shade Tent Poles.
No. 10. Report of Tobacco Station at Windsor for 1927.

CIRCULARS OF IMMEDIATE INFORMATION.

No. 61. Regulations Concerning the Transportation of Nursery Stock in the United States and Canada.

Journal Papers.

Mendel, Lafayette B. and Cannon, Helen C. The relation of the rate of growth to diet. II. Jour. Biol. Chemistry, v. 75, (1927), No. 3, p. 779.
Vickery, Hubert Bradford and Leavenworth, Charles S. On the separation of Histidine and Arginine III. The preparation of Arginine. Jour. Biol. Chem., v. 75, (1927), p. 115-122. October, 1927.
Vickery, Hubert Bradford and Leavenworth, Charles S. A note on the crystallization of free Lysine. Jour. of Biol. Chemistry, v. 76, (1928), No. 3, p. 437.

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Britton, W. E. Report of Committee on Injurious Insects. Conn. Pomol. Soc. Proc., v. 37, (1927), p. 16-19.
Britton, W. E. Oil sprays and oil injury. Jour. Economic Entomology, v. 21, p. 418-421. April, 1928.
Britton, W. E. The Elm Leaf Beetle. Tree Talk, v. 8, No. 4, p. 32. March, 1928.
Britton, W. E. Some Insect Pests of Cultivated Plants. Garden Guide (Revision A. T. de La Mare Co.), (1928), p. 293-308.
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Garman, Philip. The European red mite, peach moth and plum curculio. Conn. Pomol. Soc. Proc., v. 37, (1927), p. 28-34.
Garman, Philip. Dusting menaces fruit growers. Gleanings in Bee Culture, v. 61, p. 293-329. May, 1928.
Zappe, M. P. Fighting the apple maggot and the control of aphids. Connecticut Pomol. Soc. Proc., v. 37, (1927), p. 24-27.
Jones, D. F. Like father like son-in-law. Scientific Monthly, v. 26, (1928), p. 557-560.

WHAT THE STATION CAN DO

Each mail brings to the station requests for information and service, the range of subjects being almost without limit. Every effort is made to comply with these requests, even though they are outside the fields under investigation. This is one of the purposes for which the library is maintained. However, some of the letters request help that requires an intimate knowledge of live stock management and the like and again we are asked to make laboratory determinations for which we do not have the equipment or staff. Therefore it is helpful to publish from time to time a list of the subjects on which we can furnish information and the kinds of samples we can accept.

The Station can furnish information on:

Fertilizers and fertilization.
Soils and their management.
The chemical composition of Foods, Drugs, Insecticides and Fungicides.
The composition of Diabetic Foods.
Insect Pests of plants and their control.
Fungus and other Diseases of plants and their control.
Sprays and spraying.
Fruits and fruit management.
Weeds and their control.

Forestry—all phases.
Care of Shade Trees.
Plant breeding—especially field corn, sweet corn, fruits and vegetables.
Lawns, establishment and care.
Bees.
Mosquito Elimination.
Tobacco culture.

Samples and specimens that can be analyzed, tested or identified:

Fertilizers.
Feeding stuffs.
Foods and Drugs.
Milk—except for bacterial count.
Seeds.
Weeds and other plants.
Insects.
Diseased and injured plants.
Soils.

The Station cannot furnish information on:

Live stock feeding and management, including Poultry.
Animal diseases.
Household management.
Clothing.
Farm management.
Marketing and cooperation.

Requests for Information on these Subjects Should be Sent to the Connecticut Agricultural College at Storrs.

The Station cannot make analyses and examinations of:

Drinking water—apply to the State Board of Health, Hartford.
Milk for bacterial content—apply to the Dairy Commissioner, Hartford.
Sick or dead poultry should be sent to Poultry Department, Storrs Experiment Station, Storrs, Conn.

All of which is respectfully submitted,

William L. Slate,

Director.

Bulletin 299 January, 1929

Connecticut Agricultural Experiment Station
New Haven, Connecticut

REPORT OF

THE TOBACCO SUBSTATION

AT WINDSOR

FOR

1928

The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to other applicants as far as the editions permit.

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Press of The Wilson H. Lee Co., New Haven, Conn.

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Report of the Tobacco Substation

1928

P. J. Anderson and T. R. Swanback.

This, the seventh annual report of the Tobacco Substation is presented to the growers of Connecticut to inform them of the progress of experiments which are being conducted at this station.

On account of excessive rains, the season has not been a favorable one for the grower but in our experiments, definite progress has been registered in several of the lines of investigation and we feel that it has been a successful year from that standpoint.

The year has again been marked by increased requests from the growers for service in visiting farms, plantations and warehouses, soil testing, seed testing, personal conferences and public talks, correspondence and preparation of articles for the press. This service and contact work is extremely important, is welcomed and will be continued to the limit of our ability but the inroads which it is making on time of the station staff which can be devoted to more fundamental research emphasizes the early necessity of increasing the research staff. Mr. J. S. Owens, Extension Crop Specialist from the Agricultural College at Storrs gave a part of his time to this work and rendered valuable assistance, especially during the curing season, but the limited time which he is able to give falls far short of meeting the needs of the situation. Valuable work along this line is also being conducted by the Hartford County Farm Bureau through the efforts of the county agent, Mr. C. D. Lewis.

Especially significant has been the establishment of the tobacco advisory committee of twelve growers representing the three types of tobacco grown in the state. This committee functions both for the station and for the farm bureau and their advice and suggestions have been helpful in guiding the work of the station and in keeping it in constant touch with the growers. The members of this committee are:

Mr. Ralph G. Tryon, Glastonbury Chairman	Mr. Louis L. Grant, Manchester Mr. T. F. Holcomb, West Granby
Mr. S. R. Spencer, Suffield	Mr. J. E. Phelps, Suffield
Mr. A. T. Pattison, Simsbury	Mr. R. D. Steane, Hartford
Mr. W. H. Gowdy, Hazardville	Mr. J. B. Stewart, Windsor
Mr. J. E. Shepard, South Windsor	Mr. S. F. Brown, Windsor
Mr. R. E. Case, Granby	

The annual field day was held at the station on July 30 in co-operation with the New England Tobacco Growers Association.

It was not only largely attended by our own growers but also by ninety growers from Pennsylvania who contributed much to the success of the meeting.

In co-operation with the Connecticut Leaf Dealers Association we also prepared an exhibit for the Connecticut State Fair during the first week of September.

For some of our lines of investigation this report presents a complete discussion with all pertinent data tabulated. However, the report would be too lengthy if all projects were presented in such detail and it has seemed advisable to merely summarize the points of progress on the others and reserve for future bulletins the more complete presentation.

Potash Fertilizer Experiments

The potash requirement of the tobacco crop is very high when compared with other agricultural plants. A good potash supply is not only essential to the growth of the tobacco plant but also the presence of an abundance of potash in the proper combination in the leaf is the most important factor in producing good combustion.

Potash has at least three functions in the tobacco. 1. It acts as a catalizer or condensing agent in the formation of carbohydrates and proteins; hence the plant would cease to grow if potash were not supplied. 2. It neutralizes acids which develop during the normal metabolism of the cell and removes them to older parts of the plant where they are precipitated and rendered harmless. Otherwise these acids would accumulate in the cells to such an extent as to poison them. The spots which appear on leaves starved for potash may be due to the accumulation of these acids. This may also account for the belief by some that potash makes leaves more resistant to disease. 3. Potash acts as a catalytic agent in combustion. In this role it is absolutely necessary for the type of slow combustion which we wish in tobacco. If it is absent, the leaf burns up like paper. In these important roles potassium does not function properly when combined with the mineral radicals such as chloride or sulfate, but must be present in an organic salt like malate, tartrate or citrate. From the results of several investigations it is now generally agreed that the fire holding capacity is governed largely by the abundance of organic salts of potash which are in the leaves. The potash problem then may be summed up in one question: How can we put into the plant the maximum amount of potash in these desirable organic combinations? Obviously its supply must come from the soil through the roots since there is no other way that the plant can obtain potash. There are two possible sources of potash for the roots, (1) the native potash which is normally in the soil and, (2) fertilizer potash which the grower adds to the soil. With

respect to the first source we should inquire how much is present in our tobacco soils? In what combinations? How available to tobacco plant? How fast does it become available? Are there methods of making it more available? What is the effect of various cultural practices on its availability? With respect to the second source there arise the questions: To what extent can we

FIG. 13. Curing Sheds.

increase the potash content of the plant by increasing the soil supply? What is the optimum quantity of potash to add in fertilizers? In what carriers or combinations of carriers is it supplied to the greatest advantage? Will the plant absorb more potash from one carrier than from another? To what extent are the acid radicals with which potash is combined also absorbed and what is their effect on the tobacco? What are the effects of various potash compounds on the soil and are these effects beneficial or harmful to the crop? To what extent is potash leached? Does unused potash accumulate in the soil?

Some of these questions have been answered by the experiments of the last few years, some have been partially answered. We hope to answer others before the series of experiments is closed. The present report brings together the data which have been obtained to date and shows how far we have progressed toward answering the questions.

HOW MUCH FERTILIZER POTASH SHOULD BE APPLIED?

It is a common practice in Connecticut to apply about 200 pounds of potash (K_2O) to an acre of tobacco although some have applied much more while others have grown good tobacco on less. There are no recorded local experiments on which to base a decision as to whether as good a crop may be produced by a smaller quantity or whether better quality would be produced by a still larger quantity. According to analyses which were made in Connecticut by Jenkins (Conn. Bul. 180:7. 1914) an 1,800 pound crop of tobacco removes from the soil about 133 pounds of potash in

leaves and stalks. If the stalks are returned, the amount removed is only 85 pounds. These figures, however, give us little basis for deciding on the amount which is most advantageous since we know on the one hand that plants may take up quantities of elements which are in excess of their requirements and on the other hand that they may not be able to obtain as large a quantity as they need at a certain period even though that quantity has actually been applied to the soil and is there at the time. The safest way of deciding would seem to be actual field tests where different quantities have been applied to the same plots through a series of years and by making accurate records of the quantity and quality of the tobacco produced.

Such an experiment was begun in 1926 with six one-fortieth acre plots on Field V of the station farm. The soil here is coarse sandy loam of the Merrimac series with coarse sandy, open subsoil, subject to rapid leaching. The crop suffers here from lack of moisture during a dry year and from leaching of nitrogen in a wet year. Analyses by the Soils department show that this field contains about 35,000 lbs. of total potash per acre in the upper 8 inches of soil.

Two of the plots (K11, K11-1) received no potash in the fertilizer (except for the small quantity in the cottonseed meal and castor pomace of the formula). Two others (K12, K12-1) received 100

Composition of the three formulas was as follows:

PLOT K11. NO MINERAL POTASH

Carriers		Lbs. plant nutrient per acre		
Name	Lbs. per acre	NH_3	P_2O_5	K_2O
Cottonseed meal	1463.4	120	42.4	21.9
Castor pomace	588.2	40	10.6	5.9
Nitrate of soda	212.7	40		
Precipitated bone	277.9		107.0	
Total	2542.2	200	160.0	27.8

PLOT K12. ONE HUNDRED POUNDS POTASH

Carriers		Lbs. plant nutrient per acre		
Name	Lbs. per acre	NH_3	P_2O_5	K_2O
Cottonseed meal	1463.4	120	42.4	21.9
Castor pomace	588.2	40	10.6	5.9
Nitrate of soda	170.2	32		
Precipitated bone	277.9		107.0	
Sulfate of potash	48.0			24.0
Carbonate of potash	37.1			24.1
Nitrate of potash	53.5	8		24.1
Total	2638.3	200	160.0	100.0

PLOT K9. TWO HUNDRED POUNDS POTASH

Carriers		Lbs. plant nutrient per acre		
Name	Lbs. per acre	NH_3	P_2O_5	K_2O
Cottonseed meal	1463.4	120.0	42.4	21.9
Castor pomace	588.2	40.0	10.6	5.9
Nitrate of soda	107.4	20.2		
Precipitated bone	277.9		107.0	
Sulfate of potash	114.8			57.4
Carbonate of potash	88.3			57.4
Nitrate of potash	132.3	19.8		57.4
Total	2772.3	200.0	160.0	200.0

lbs. of potash per acre. The other two (K9, K9-1) received the standard quantity, 200 lbs. per acre. Potash was supplied in equal amounts from sulfate, nitrate and carbonate because previous experiments had shown most favorable results from this triple combination of potash salts, and also in order to minimize the effect of possible accumulation of any one acid radical.

During the first year of the experiment no differences in growth were observed. The growth on all of these plots, however, was unsatisfactory on account of the dry weather and no conclusion was drawn from the records.

However, when the same plots were treated in the same way the second year (1927), the growth throughout the season appeared smaller on the no-potash plots but no differences between the others were apparent.

When sorted, the tobacco from the no-potash plots, was found to be short, yellow and of poor quality but as between the others the differences were not large. The sorting records are presented in Table 1.

TABLE I. QUANTITY OF POTASH SERIES. CROP OF 1927 ON FIELD V

Potash per A.	Plot No.	Acre Yield		Percentage of grades								Grade index*	
		Plot	Ave.	L	M	LS	SS	LD	DS	F	B	Plot	Ave.
0	K11	1150	1144	..	..	18	6	36	7	20	13	.281	.290
	K11-1	1137		..	..	18	11	41	4	16	10	.298	
100	K12	1247	1194	6	7	15	9	42	2	16	3	.368	.366
	K12-1	1141		6	5	14	8	42	5	16	4	.364	
200	K9	1152	1152	10	10	15	8	38	4	10	6	.411	.411

* *The Grade Index.* In comparing the quality of tobacco grown on different plots it is very difficult to keep in mind the percentage of six to eight commercial grades of tobacco from one plot and compare with a like number from another. To simplify these comparisons a grade index was devised. The grade index is a single number expressing the quality of *all*

These data show that there was a slight reduction in yield but a very decided reduction in grading during the second year where no potash was added.

The same treatment was repeated on the same plots in 1928 (3d year). During the summer it was quite apparent that the plots which received no potash were not making as good growth as the others. Distinct symptoms of acute potash hunger, however, were not seen.

In taking down the tobacco from the shed it was found that tobacco from the no-potash plots did not come "into case", i. e., become soft and pliable, during the "damps". Adjacent plots were in excellent condition for handling while this tobacco was hard and dry and never became really ready to take down. The same was true, but to a smaller degree, with tobacco from the plots where only 100 lbs. per acre of potash had been applied.

FIG. 14. Feeding the crop. Shade growers use two tons of fertilizer to the acre.

On the sorting bench, the tobacco from the no-potash plots was found to be yellow, short, thick, "boardy", entirely lacking in elasticity and of such inferior quality generally that it was not fit to sort. Tobacco from the 100 lbs.-potash plots was somewhat

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the tobacco grown on a particular plot. It is based on the percentage of carefully assorted commercial grades and the relative price value of the different grades. Although market prices vary from year to year, it was found, after consultation with experienced dealers, that the ratios of prices between the different grades are fairly constant. These adopted price relationships for the different grades are as follows:

(L)	Light wrappers.....	1.00	(LD)	Long darks (19″ up).	.30
(M)	Medium wrappers...	.60	(DS)	Dark stemming (17″)	.20
(LS)	Long sec. (19″ up)...	.60	(F)	Fillers.....	.10
(SS)	Short seconds (15″ and 17″).....	.30	(Br)	Brokes.....	.10

The grade index of any plot is obtained by multiplying the percentage of each grade by the price in the above schedule and adding the products.

longer but showed much of the same characters as above but to a less degree. Tobacco from the "200 lbs.-potash" plots was rated as satisfactory.

The sorting records for the 1928 crop are presented in Table 2.

TABLE 2. QUANTITY OF POTASH. SERIES OF 1926. ACRE YIELD AND GRADING OF CROP OF 1928

Quantity of potash	Plot No.	Acre Yield		Percentage of grades								Grade Index	
		Plot	Ave.	L	M	LS	SS	LD	DS	F	B	Plot	Ave.
0	K11	1107	1135	..	..	..	21	..	67	27	..	.194	.214
	K11-1	1163		..	..	..	21	38	15	21	5	.233	
100	K12	1107	1092	3	7	9	25	24	16	16	..	.321	.322
	K12-1	1076		3	5	13	15	31	15	18	..	.324	
200	K9	1178	1199	13	9	12	18	31	8	9	..	.428	.463
	K9-1	1221		22	16	5	17	30	1	9	..	.498	

It appears from these data that the reduction in quality is much more serious than the decrease in yield when potash is omitted from the fertilizer. When 100 lbs. of potash was supplied the quality was somewhat improved but was still much inferior to the tobacco receiving the regular ration. Tobacco from the 200 lbs.-plots was of good quality exhibiting none of the dry, thick, non-elastic, yellow characters of the other plots.

In the Field V experiments just described all treatments were in duplicate. After the first year it was decided to increase the number of replications and enlarge the experiment also by adding 300 lbs.-potash plots. These additional plots were on Field I, a soil of a somewhat different type, being a fine sandy Merrimac loam with a more compact subsoil and less subject to leaching. This field usually grows better tobacco than Field V. The complete lay-out of plots was now as follows:

K11	No potash	6 plots
K12	100 lbs. potash	5 "
K9	200 " "	6 "
K13	300 " "	5 "

During the first year of the new series no differences in growth were observable in the field but the sorting records as presented in Table 3 show that there was a slight reduction both in yield and grading when potash was omitted from the fertilizer.

During the second season (1928) when all treatments were repeated on the same plots on Field I, the effect of the entire omission of potash was apparent in the field. The plants appeared smaller and less "leafy", i. e., they did not seem to fill out the rows as well. The sorting records for this crop, however, do not indicate a reduction in yield. Probably the thickness of the leaves com-

FIG. 15. Transplanter at work under the tent.

TABLE 3. QUANTITY OF POTASH. FIELD I SERIES. SORTING RECORDS ON CROP OF 1927

Potash lbs. per A	Plot No.	Acre Yield		Percentage of grades								Grade inde	
		Plot	Ave.	L	M	LS	SS	LD	DS	F	B	Plot	Av
0	K11-2	1230	1184	8	9	17	6	40	3	11	6	.397	.3
	K11-3	1213		7	5	25	6	36	4	11	6	.401	
	K11-4	1160		2	4	14	6	39	6	16	13	.304	
	K11-5	1152		3	5	19	6	42	2	13	10	.345	
	K11-6	1163		8	7	20	7	38	2	13	5	.399	
100	K12-2	1287	1274	7	8	18	4	38	4	13	8	.381	.3
	K12-3	1384		9	11	18	9	35	4	10	4	.418	
	K12-4	1152		4	7	19	7	38	2	14	9	.358	
200	K9-5	1321	1286	4	8	22	4	40	3	14	5	.377	.3
	K9-6	1312		6	6	21	5	37	3	13	9	.364	
	K9-7	1258		6	4	18	7	37	6	14	8	.358	
	K9-8	1254		8	6	19	6	43	2	11	5	.397	
300	K13	1230	1264	7	4	24	7	36	2	10	10	.391	.3
	K13-2	1316		9	10	19	5	36	4	12	5	.412	
	K13-3	1325		11	8	19	7	36	3	13	3	.423	
	K13-4	1205		8	7	23	6	34	3	12	7	.405	
	K13-5	1246		2	4	25	10	33	5	12	9	.354	

TABLE 4. QUANTITY OF POTASH. FIELD I SERIES. ACRE YIELD AND GRADING OF CROP OF 1928

Quantity of potash	Plot No.	Acre Yield		Percentage of Grades							Grade index	
		Plot	Ave.	L	M	LS	SS	LD	DS	F	Plot	Ave.
0	K11-2	1259	1206	4	4	22	12	32	11	15	.365	.357
	K11-3	1114		2	8	29	10	33	6	12	.395	
	K11-4	1152		7	3	11	24	29	12	14	.351	
	K11-5	1185		4	7	9	25	32	7	16	.337	
	K11-6	1312		5	5	19	16	32	7	16	.368	
	K11-7	1216		1	3	17	22	32	11	14	.328	
100	K12-2	1202	1197	7	6	30	11	34	2	10	.435	.419
	K12-3	1306		18	8	17	11	33	3	10	.478	
	K12-4	1083		7	7	7	28	20	17	14	.346	
200	K9-5	1403	1238	15	13	17	11	31	3	10	.472	.458
	K9-6	1229		8	9	29	9	32	5	8	.449	
	K9-7	1063		9	6	17	14	21	18	15	.394	
	K9-8	1257		25	10	13	11	26	4	11	.518	
300	K13	1106	1207	13	10	22	11	26	7	11	.464	.446
	K13-1	1200		24	12	9	12	22	9	12	.498	
	K13-2	1355		5	5	27	15	36	2	10	.409	
	K13-3	1234		12	10	19	13	34	2	10	.449	
	K13-4	1138		11	6	19	16	19	18	11	.412	

pensated for their smaller size. There was, however, a decided reduction in quality when no potash was applied, the cured leaves being short, yellow, heavy and non-elastic. This is reflected in the lower grade index (Table 4). Tobacco from the 100 lbs.-potash plots was not quite as good as that from the 200 lbs.-plots. There were no significant differences between the 200 lbs. and the 300 lbs.-plots.

In general, the results from the Field I series confirm those from Field V series.

Wilting due to lack of potash. During hot days, tobacco leaves wilt and flag. During the summer of 1928 it was commonly observed on the above experiments and also in other tests on shade tobacco that the no-potash plots wilt first, and at all times the wilting is more pronounced on these plots.

Effect of quantity of fertilizer potash on burn. Strip burn tests were made on the crops of 1926 and 1927 as recorded on p. 171 These showed only a slight reduction in fire holding capacity the first year after potash is omitted, but serious reduction during the second year. One hundred pounds of potash per acre seems to have been enough to keep up the fire holding capacity, during two years.

Effect on the chemical composition of the leaves. Samples from the crop of 1926 (first year of test) were analyzed by Dr. E. M. Bailey of the chemistry department to see what effect the omission or reduction of fertilizer potash would have on the quantity of potash absorbed. The results presented in Table 5 show a consistent reduction in potash even for the first year and furnish reason to believe that the potash content of the leaves may be very materially affected by the quantity applied to the soil.

TABLE 5. QUANTITY OF POTASH IN LEAVES FROM PLOTS WITH REDUCED FERTILIZER POTASH. CROP OF 1926

Grades	Percent of potash in leaves when each acre received		
	No. Fert. potash	100 lbs. Fert. potash	200 lbs. Fert. potash
Darks	6.96	7.20	7.97
Seconds	7.03	7.33	8.32
Both	**7.00**	**7.27**	**8.15**

Conclusions. Despite the fact that this soil contains naturally very large quantities of potash it is obvious from these experiments that the availability of the native supply is so low that regular yearly applications in the fertilizer are necessary. When all potash is omitted from the fertilizer, the quality is slightly reduced the first year, seriously reduced the second year and the product is so inferior the third year that it is not worth sorting. The reduction in weight has not been so serious as in quality. One hundred pounds of potash per acre is not enough to keep up the quality for more than one year. As between 200 and 300 pounds, no differences have appeared in two years. Until further data are at hand it would seem best to use 200 pounds per acre although the possibility is not precluded that the minimum application may be somewhat lower or higher.

WHAT CARRIERS OF POTASH ARE BEST?

There are a number of forms (carriers) in which potash may be added to the fertilizer mixture. Although the element, potassium, is the same from all sources, nevertheless it is a mistake to believe that equal results can be secured irrespective of the form in which it is supplied. New England tobacco growers learned, for instance, many years ago that potash could not be supplied in the form of muriate because it ruined the burn. Such differences and resultant preferences are due to the acid radicals and other undesirable companions of potassium which may either affect the soil adversely or produce unfavorable effects when they enter the plant and change the composition of the leaves. Thus sulfate of potash and double sulfate of potash-magnesia are objectionable because too

much sulfur in the plant reduces the fire holding capacity. Carbonate may cut down the yield. Nitrate may introduce too much nitrogen in the nitrate form. Cottonhull and wood ashes may have an unfavorable effect on soil because of caustic lime, etc. When one tries to make selection among them by theorizing on their possible effects he is confronted with so many conflicting possibilities that he is forced to the final conclusion that the only way of coming to a decision is through actual field tests. It is for this reason that a large number of the experimental plots on the station farm are now devoted to a comparison of different forms of potash. These experiments are being conducted under the most carefully controlled conditions we are able to maintain and every record possible is being made on them. Such experiments must ultimately answer the question proposed, at least as far as this type of soil is concerned.

In Table 6 all the sources of potash which have been used commonly in this section are listed with their essential analyses. Most of these are now included in the tests at the station or elsewhere.

TABLE 6. AVERAGE ANALYSES OF POTASH CARRIERS WHICH MAY BE USED FOR TOBACCO

Name of Carrier	Percentage of plant food						
	Potash (K_2O)	Nitrogen (N)	Phos. Acid (P_2O_5)	Lime (CaO)	Magnesia (MgO)	Sulf. Acid (SO_3)	Chlorine (Cl)
Sulfate of Potash	50	....	....	0.2	1.3	43.6	1.6
Nitrate of Potash[1]	44	12.5	....	....	....	....	0.6
Nitrate of Potash-Soda	12.0	14.5	....	....	....	....	0.7
Carbonate of Potash	64	....	....	....	....	....	0.5
Sulf. Potash-Magnesia	28	....	....	....	11.3	46.7	2.0
Wood Ashes[2]	6.6	....	2.1	36.6	5.7	1.2	0.5
Cottonhull ashes[2]	25	....	9.8	5.2	11.2	2.4	0.2
Tobacco Stems[2]	6.4	2.1	0.6	3.8	0.5	0.5	0.5
Cow manure[3]	0.5	0.4	0.3	0.2	0.1	0.1	0.1
Horse manure[3]	0.6	0.4	0.7	0.5	0.2	0.1	0.1

Since the purpose and progress of these experiments have been discussed in previous reports, they will not be repeated here but the present discussion will be confined to results of the last year or two and comparisons with those of the preceding years.

[1] German synthetic or Calcutta.
[2] Composition variable.
[3] Containing 60-70% water.

COMPARISON OF HIGH GRADE SULFATE WITH SULFATE OF POTASH-MAGNESIA

The possible benefit to be derived from the substitution of sulfate of potash-magnesia (double manure salts) for the more common sulfate of potash, lies in its content of magnesia which is essential for the growth of tobacco and without which the plant suffers from the malnutrition trouble commonly called sand-drown.

TABLE 7. COMPARISON OF HIGH GRADE SULFATE OF POTASH WITH DOUBLE MANURE SALTS. YIELD AND GRADES FOR CROP OF 1928

Source of potash	Plot No.	Acre Yield		Percentage of Grades							Grade index	
		Plot	Ave.	L	M	LS	SS	LD	DS	F	Plot	Ave.
High Grade Sulphate	K1	1309	1295	24	14	13	13	24	4	8	.529	.52
	K1-1	1280		24	10	14	12	27	2	11	.516	
Double Man. Salts	K2	1313	1315	22	13	14	13	28	2	8	.517	.49
	K2-1	1318		16	9	21	13	29	3	9	.481	
Half from Each	K3	1341	1354	19	8	19	11	28	4	01	.488	.48
	K3-1	1378		17	10	17	13	27	4	12	.472	

Just as in the preceding five years (See Tob. Sta. Buls. 5, p. 24; 6, p. 22; 8, p. 36), two of the plots (K1, K1-1) had all of their potash in the form of high grade sulfate, two more (K2, K2-1) all from double manure salts, and the other two (K3, K3-1) had the potash derived equally from the two sources. The growth in 1928 was uniform but light on account of the heavy rains during the growing season. No differences were observed during the summer between the various plots except for a trace of sand-drown on the K1 plots just before harvest but this never became of any importance. It was not observed at any time during the preceding five years. When the tobacco from these six plots was sorted, no signs of magnesia hunger were observed, all the tobacco being rated as satisfactory and of good quality.

Table 7, showing sorting results of the season of 1928, indicates a somewhat higher yield from the use of the two potash carriers in combination but a somewhat higher grade index from the use of high grade sulfate alone. Table 8, showing yields during six years of this experiment, indicates only a very slight difference (about 1%) in favor of the combination. Table 9, showing the grade index for 5 years, shows a very slight higher average for the high grade sulfate.

Differences in chemical composition. In order to see whether any chemical changes in the composition of the leaf had been caused by the substitution of double manure salts for high grade

TABLE 8. COMPARISON OF HIGH GRADE SULFATE WITH DOUBLE MANURE SALTS. ACRE YIELDS FOR SIX YEARS

Source of potash	Plot No.	Grade index by years						Plot Ave.	Average 12 replications
		1923	1924	1925	1926	1927	1928		
igh Grade Sulfate	K1	2056	1333	2054	1739	1223	1309	1619	1630
	K1–1	2056	1387	2061	1832	1223	1280	1640	
ouble Man. Salts	K2	1966	1413	1932	1831	1355	1313	1635	1622
	K2–1	1966	1413	1892	1833	1234	1318	1609	
alf from each	K3	2039	1467	2029	1712	1364	1341	1669	1638
	K3–1	2039	1333	1929	1648	1382	1378	1618	

sulfate, samples of seconds and darks for all plots were analyzed by the Station Chemistry Department. Since in double manure salts, considerably more magnesia and sulfur are added to the soil it was anticipated that a larger percentage of these elements would be found in the leaf. In view of the importance of potash in the burn, it also seemed desirable to learn whether the amount of

TABLE 9. COMPARISON OF HIGH GRADE SULFATE WITH DOUBLE MANURE SALTS. GRADE INDICES FOR 5 YEARS

Source of potash	Plot No.	Grade index by years					Plot Ave.	Average 12 replications
		1924	1925	1926	1927	1928		
H. G. Sulfate	K1	.281	.475	.471	.356	.529	.422	.436
	K1-1	.291	.475	.505	.457	.516	.449	
Double Manure Salts	K2	.281	.476	.479	.468	.517	.444	.433
	K2-1	.273	.471	.500	.383	.481	.422	
Half from each	K3	.316	.461	.475	.466	.488	.441	.425
	K3-1	.270	.483	.461	.357	.472	.409	

potash absorbed had been affected. Since calcium and magnesium have a somewhat complementary relation in the tobacco plant it was also decided to determine the percentage of calcium. The results of the chemical analyses for crop of 1926 are summarized in Table 10.

From these analyses it is apparent that the use of double manure salts has greatly increased the magnesia content of the leaves and correspondingly reduced the calcium. Both total sulfur and sulfate sulfur have been increased. The percentage of potash absorbed was slightly reduced, especially in the seconds.

Effect on the burn. Since it is generally conceded that burn is roughly proportional to the potash which may form combinations with the organic acids after the mineral acids(sulfuric, hydrochloric, nitric, phosphoric) have been neutralized, it would be

anticipated that the small increase in sulfate sulfur and reduction in potash would be reflected in a corresponding reduction in fire holding capacity. Burn tests on these same samples of 1926, published in Bul. 10, Table 5 (before the chemical analyses were made) show that such was the case. This is confirmed by tests for two more years reported on p. 168 of the present bulletin.

TABLE 10. SUMMARY OF CHEMICAL ANALYSES OF TOBACCO FROM HIGH GRADE SULFATE AND DOUBLE SULFATE PLOTS. CROP OF 1926

Averages of duplicate plots

Source of potash	Grade of leaf	Percentage in water free leaf				
		Potash (K_2O)	Total Sulfur	Sulfate Sulfur	Lime (CaO)	Magnesia (MgO)
H. G. Sulfate	Darks	7.23	0.84	0.72	5.81	1.17
	Sec.	8.07	0.72	0.58	6.84	1.41
	Both	**7.65**	**0.78**	**0.65**	**6.32**	**1.29**
Double manure salts	Darks	7.05	1.00	0.87	4.76	1.97
	Sec.	7.54	0.81	0.69	5.94	2.28
	Both	**7.30**	**0.90**	**0.78**	**5.35**	**2.13**
Half from each	Darks	6.98	0.86	0.73	5.84	1.49
	Sec.	7.33	0.70	0.59	6.88	1.64
	Both	**7.16**	**0.78**	**0.66**	**6.36**	**1.56**

Character of soil. The soil on which these plots are located is a Merrimac sandy loam with some fragments of red sandstone in the surface. It has never leached seriously nor does it suffer excessively from dry weather. It produces a heavier and better crop on a relatively dry year than on a wet year. It is not the type of soil which suffers excessively from sand-drown.

Conclusions from the six year experiments. The original purpose of this experiment was to find whether any advantage would accrue from the substitution of sulfate of potash-magnesia (25% K_2O) for high grade sulfate (48% K_2O) as a source of potash in the tobacco mixture. At the end of six years we believe this question has been answered for this particular type of soil as nearly as it can be answered by field and laboratory tests. Two of these years were excessively wet (conducive to sand-drown), one was excessively dry, one just a little too dry, and the other two about optimum in rainfall.

When the records of the six years are averaged, the differences in yield and quality are found to be very small—probably too small to be important. Offsetting a somewhat larger yield from the use of the combination of the two carriers, there is a small advantage in grading and fire holding capacity from use of high grade sulfate. It may be stated definitely that there is no advantage in taking **all** the potash from double manure salts. On this

type of soil there has been no advantage in getting **any** of it from that source. In more sandy, "leachy" locations, however, it is conceivable that the use of 100 or 200 pounds of double sulfate per acre might result in some advantage unless there are other sources of magnesia present. If our tobacco mixtures of the future are to include a smaller amount of vegetable organics (which contain magnesia)—as seems likely from present trends—it is certain that some carriers of magnesia must be included.

The disadvantages attending the use of double manure salts are (1) somewhat higher cost of the potash, (2) handling of a greater bulk of low grade material, (3) raising the sulfur content of soil and leaf, (4) lowering the potash content, and (5) consequent reduction of fire holding capacity.

COMPARISON OF SULFATE, CARBONATE AND NITRATE OF POTASH

This experiment was begun in 1925. Results of first two years are given in Tobacco Sta. Bul. 6, p. 25 and Bul. 8, p. 39. The object of the experiment is to compare the effect of these three carriers of potash on the yield and quality of tobacco. Using our standard formula as a base and with all other ingredients the same in all, the following five sources of potash, or combinations of sources were used:

PLOT
K1, all potash in H. G. Sulfate.
K5, all potash in carbonate.
K7, 2–3 of the potash in nitrate*, the other 1–3 in carbonate.
K8, ½ of the potash in sulfate, ½ in carbonate.
K9, potash derived equally from sulfate, carbonate and nitrate.

The exact formula for each of these plots is tabulated in Bul. 6. The quantity of ammonia, phosphorus and potash was the same for all plots. The experiment was begun with 10 plots on Field V where the soil is very sandy and the yield is never large. Each treatment is in duplicate on these original plots.

Since growth on this part of the field is usually not as good as might be wished and since results can be obtained more quickly and with more certainty by using a larger number of replications, the experiment was enlarged in 1927 by repeating the same treatments in triplicate on Field I. These two sets of plots give us five replications of each treatment every year. It is believed that this number is sufficiently large to ensure reliable data in a few years.

It will be noted from the above that the two series of plots (series of 1925 and series of 1927) are on somewhat different types

*In explanation of the K7 formula, it did not seem desirable to derive all the potash from nitrate because this would make a greater proportion of the nitrogen from mineral sources (in nitrate form) than we had in the other formulas and would thus introduce another variable.

of soil, the first being Merrimac coarse sandy loam with rapid drainage and therefore suffering from dry weather and from leaching, the second series on Merrimac sandy loam with a tighter subsoil giving slower drainage and therefore better for a dry year but too slow for a wet year. It is not prone to leaching. It will be most convenient to discuss these two series separately.

Series of 1925. Composition of the fertilizer mixtures applied to these plots is described in Bul. 6, p. 27. Significant differences in growth between the various plots were not observed during the summer of any of the four years of this test.

Sorting results for 1928 are presented in Table 11. These data indicate somewhat the best yield for the combination of sulfate, carbonate and nitrate and the best grading for nitrate and carbonate. The differences, however, are quite small. Carbonate alone has the lowest grading, due to the very poor showing of the single plot, K5. Yield on all plots was unusually light due to the very wet season.

TABLE 11. COMPARISON OF SULFATE, CARBONATE AND NITRATE OF POTASH. SERIES OF 1925. YIELD AND GRADING FOR CROP OF 1928

Carriers of potash	Plot No.	Acre yield lbs.		Percentage of Grades							Grade Inde	
		Plot	Ave.	L	M	LS	SS	LD	DS	F	Plot	Ave
Sulphate	K1-2	1095	1169	19	10	5	18	27	13	8	.449	.4
	K1-3	1234		17	12	5	18	32	8	8	.446	
Carbonate	K5	1077	1134	7	10	11	14	25	20	13	.366	.4
	K5-1	1190		28	14	3	15	20	13	7	.520	
⅔ Nitrate ⅓ Carbonate	K7	1126	1158	21	14	9	11	28	6	11	.488	.4
	K7-1	1190		17	15	11	11	27	9	9	.468	
½ Sulphate ½ Carbonate	K8	1139	1179	14	9	14	17	20	17	9	.432	.4
	K8-1	1220		21	14	7	17	26	6	9	.486	
⅓ Carbonate ⅓ Sulfate ⅓ Nitrate	K9	1178	1199	13	9	12	18	31	8	9	.428	.4
	K9–1	1221		22	16	5	17	30	1	9	.498	

In Table 12 the yield and grading data on these plots for 4 years are summarized. The low average for both yield and grading on the sulfate and carbonate plots are due to the poor showing of plots K1-2 and K5. These two plots are in one corner of the field where a building previously stood. As a result, these two plots have not grown as well as the others of this series. If, for the sake of fairness, these two plots were excluded from our calculations the average yield for the K1 plots would be 1,325 lbs. and grade index, .405. For the carbonate plots the corresponding figures

would be 1,305 and .425. Carbonate would thus have the highest grade index but lowest yield, which is in accord with our previous observations. The excellent showing which the triple combination (K9) has shown both in yield and grading throughout the series leads us to favor this as the best source of potash.

TABLE 12. COMPARISON OF SULFATE, CARBONATE AND NITRATE OF POTASH. SERIES OF 1925. YIELD RECORDS AND GRADE INDEX FOR 4 YEARS.

Source of potash	Plot No.	Acre yield by years				Ave. of Treatment	Grade index by years				Ave. of Treatment
		1925	1926	1927	1928		1925	1926	1927	1928	
ulfate	K1-2	1418	1135	1099	1095	1256	.316	.307	.276	.449	.371
	K1-3	1553	1294	1222	1234		.412	.351	.409	.446	
arbonate	K5	1425	1325	1089	1077	1267	.317	.331	.273	.366	.373
	K5-1	1545	1312	1176	1190		.405	.343	.430	.520	
Nitrate	K7	1434	1350	1100	1126	1305	.407	.328	.337	.488	.392
Carb'ate	K7-1	1695	1393	1155	1190		.409	.381	.317	.468	
Sulfate	K8	1458	1362	1164	1139	1308	.381	.353	.322	.432	.392
Carb'ate	K8-1	1497	1403	1222	1220		.396	.388	.377	.486	
Sulfate	K9	1563	1372	1152	1178	1316	.369	.364	.411	.428	.399
Carb'ate	K9-1	1524	1424	1093	1221		.382	.388	.350	.498	

TABLE 13. COMPARISON OF SULFATE, CARBONATE AND NITRATE OF POTASH. SERIES OF 1927. ACRE YIELD AND GRADING OF CROP OF 1928

Carriers of potash	Plot No.	Acre yield		Percentage of grades							Grade index	
		Plot	Ave.	L	M	LS	SS	LD	DS	F	Plot	Ave.
	K1-4	1410		13	16	16	12	21	12	10	.455	
	K1-5	1335		..	3	39	11	35	3	9	.405	
ulfate	K1-6	1476	1397	3	6	36	9	34	2	10	.425	.437
	K1-7	1366		3	5	33	11	32	5	11	.408	
	K1-8	1356		10	9	26	11	31	2	11	.511	
	K1-9	1442		6	6	31	10	27	7	13	.420	
	K5-2	1320		11	5	24	16	20	15	9	.431	
rbonate	K5-3	1261	1333	16	10	21	8	32	2	11	.481	.470
	K5-4	1419		15	13	24	9	30	1	8	.499	
Nitrate	K7-2	1394		6	8	26	14	28	8	10	.416	
Carbonate	K7-3	1330	1380	20	11	18	11	29	2	9	.507	.438
	K7-4	1416		0	4	37	15	24	9	11	.392	
Carbonate	K8-2	1331		2	4	40	11	25	6	12	.416	
Sulfate	K8-3	1391	1389	3	5	28	19	25	9	11	.389	.421
	K8-4	1445		12	9	22	15	31	3	8	.458	
Carbonate	K9-2	1194		3	3	28	21	27	7	11	.385	
Sulfate	K9-3	1353	1347	5	6	37	8	31	3	10	.441	.426
Nitrate	K9-4	1495		9	11	26	12	30	2	10	.452	

Series of 1927. This series is a duplicate of the 1925 series (three additional replications of each treatment) on Field 1 as explained above. The fertilizer treatment for 1928 was identical with that for the previous series but ground limestone at the rate of 400 lbs. per acre was added because this soil was considered too acid for best results. Growth was satisfactory and uniform but yield was much reduced by the extremely wet season.

Sorting results on this series, presented in Table 13, indicate slightly highest yield for the sulfate plots and best grading for the carbonate plots.

Summary of results for two years in Table 14 also show the best grading for the carbonate plots but the lowest yield. The triple combination (K9) had somewhat the best average yield.

TABLE 14. COMPARISON OF SULFATE, CARBONATE AND NITRATE OF POTASH SERIES OF 1927. SUMMARY OF 2 YEARS

Source of potash	Plot No.	Acre yield			Average for Treatment.	Grade index			Avera for Treatm
		1927	1928	Ave.		1927	1928	Ave.	
Sulfate	K1-4	1273	1410	1342	1342	.394	.455	.425	.41
	K1-6	1261	1476	1318		.372	.425	.399	
	K1-8	1276	1356	1316		.345	.511	.428	
Carbonate	K5-2	1230	1320	1275	1297	.410	.431	.421	.43
	K5-3	1246	1261	1254		.394	.481	.438	
	K5-4	1307	1419	1363		.421	.499	.460	
⅔ Nitrate ⅓ Carbonate	K7-2	1271	1394	1333	1330	.419	.416	.418	.40
	K7-3	1250	1330	1290		.380	.507	.444	
	K7-4	1318	1416	1362		.326	.392	.359	
Sulfate	K1-5	1250	1335	1293	1329	.389	.405	.397	.40
	K1-7	1258	1366	1312		.413	.408	.411	
	K1-9	1320	1442	1381		.380	.420	.400	
½ Sulfate ½ Carbonate	K8-2	1319	1331	1325	1352	.396	.416	.406	.41
	K8-3	1280	1391	1336		.369	.389	.379	
	K8-4	1345	1445	1395		.463	.458	.461	
⅓ Sulfate ⅓ Carbonate ⅓ Nitrate	K9-2	1292	1394	1343	1356	.414	.385	.400	.41
	K9-3	1319	1353	1336		.365	.441	.403	
	K9-4	1284	1495	1390		.403	.452	.428	

TOBACCO STEMS AS A SOURCE OF POTASH

Tobacco stems (midribs of the leaf) contain about 6% of potash and for many years have been used by some growers for tobacco land. Besides potash, they also contain around 2.1% nitrogen, .5% phosphoric acid and about 4% of lime. They also add organic matter to the soil.

In order to see whether they can be used to advantage as the only source of potash, three plots were included in the potash series of Field 1 in 1927. The formula for these plots was as follows:

Carrier	Pounds per acre	Nutrients per acre		
		NH_3	P_2O_5	K_2O
Stems	2810	73.1	14	179.8
Cottonseed meal	1060	86.9	30.7	20.2
Nitrate of soda	212.7	40.0		
Total.....		200	44.7	200

The stems were applied at the same time as the fertilizer in 1927. The yield and sorting data are presented in Table 15.

TABLE 15. YIELD AND SORTING DATA ON STEMS PLOTS. CROP OF 1927

No. of plot	Yield per acre		Percentage of grades								Grade index	
	Plot	Ave.	L	M	LS	SS	LD	DS	F	B	Plot	Ave.
K14	1222		9	7	12	8	40	4	13	7	.376	
K14-1	1186	1266	4	4	25	5	39	3	12	8	.372	.394
K14-2	1390		12	7	19	7	41	1	9	4	.435	

The replicates in this series are not very consistent since the K14-2 plot was very much higher than the others both in yield and quality. The average of both yield and grade index is about the same as for the sulfate of potash plots (K1-5, K1-7, K1-9) which were immediately adjacent to them.

This series of three plots on Field 1 was continued in 1928, the fertilizer being the same except for the addition of 400 lbs. of limestone per acre. The stems were plowed under in the spring.

The sorting data for 1928 are presented in Table 16 along with corresponding data from the sulfate and carbonate plots for comparison. From these data it is apparent that there has been as good yield and quality as where other sources of potash have been used. The grading is particularly good.

TABLE 16. STEMS AS A SOURCE OF POTASH. ACRE YIELD AND GRADING OF CROP OF 1928

Source of potash	Plot No.	Acre yield		Percentage of grades							Grade index	
		Plot	Ave.	L	M	LS	SS	LD	DS	F	Plot	Ave.
	K14	1292	....	11	11	24	14	24	8	8	.498	
tems	K14-1	1369	1346	..	..	..	..	..	..	..	....	.486
	K14-2	1378	....	15	12	18	12	31	4	8	.475	
ulfate	6 plots		1397	..	..	..	..	..	..	..	....	.437
arbonate	3 plots		1333	..	..	..	..	..	..	..	....	.470

EFFECT OF DIFFERENT POTASH CARRIERS ON REACTION OF THE SOIL

In order to see whether the continuous application of any one or any combination of these potash carriers would shift the reaction of the soil, samples were taken from the ten plots in the 1925 series, (1) before sowing the fertilizer each year and (2) just after harvesting the crop. The reaction was determined electrometrically with results as follows:

TABLE 17. SOIL REACTION (pH) OF POTASH PLOTS. SERIES OF 1925

Source of potash	Plot No.	1925		1926		1927		1928		
		May	Sept.	May	Aug.	May	Sept.	May	July 13*	Aug. 7
Sulfate	K1-2	6.02	5.84	6.03	5.73	6.08	5.94	5.81	5.74	5.79
	K1-3	5.09	5.00	5.21	4.65	5.10	4.75	5.08	4.67	4.82
Carbonate	K5	5.53	5.45	5.72	5.45	5.89	5.42	5.59	5.51	5.39
	K5-1	5.21	5.25	5.31	5.11	5.32	5.25	5.24	4.99	5.02
⅔ Nitrate	K7	5.31	5.40	5.47	4.93	5.62	5.09	5.31	5.04	5.03
⅓ Carbon.	K7-1	5.30	5.03	5.12	4.41	5.19	4.71	5.10	4.93	4.87
½ Sulfate	K8	5.26	5.27	5.41	4.93	5.54	5.29	5.40	5.05	5.23
½ Carbon.	K8-1	5.10	5.05	5.04	5.19	5.18	4.81	5.08	4.92	4.96
⅓ Sulfate	K9	5.05	5.15	5.19	5.02	5.47	5.06	5.16	5.09	5.15
⅓ Carbon.	K9-1	5.05	5.12	4.95	4.84	5.33	5.05	5.02	4.95	5.00
⅓ Nitrate										

* Crop two-thirds grown.

Although the reactions have varied considerably during the four years of this test, there seems to be no definite trend in any one direction for any of the plots. Comparing the reactions of May, 1925 with those of May, 1928, they are found to be almost identical in all cases. The result is the same when the reactions of September, 1925 are compared with those of August, 1928. We may conclude from this that when such potash carriers in these quantities are applied annually to this type of soil there is very little if any permanent change in reaction.

EFFECT OF POTASH CARRIERS ON THE CHEMICAL COMPOSITION OF THE TOBACCO

For reasons previously mentioned it is desirable to get the plant to absorb as much potash as possible and to keep the sulfur content low. In order to see whether the potash carrier has any effect on the quantity of these elements absorbed, samples from the ten plots of the series of 1925 were analyzed by the Station Chemistry Department. Two grades, seconds and darks of the crop of 1926,

were taken from each plot. Summary of the analyses are presented in Table 18.

TABLE 18. POTASH AND SULFUR CONTENT OF TOBACCO TREATED WITH DIFFERENT CARRIERS OF POTASH. AVERAGES OF DUPLICATES

Source of potash	Grades	Total Sulfur	Potash
Sulfate	Darks	0.57	8.31
	Seconds	0.57	8.66
	Both	**0.57**	**8.49**
Carbonate	Darks	0.50	7.76
	Seconds	0.43	8.47
	Both	**0.46**	**8.13**
⅔ Nitrate ⅓ Carbonate	Darks	0.43	8.38
	Seconds	0.43	8.62
	Both	**0.43**	**8.50**
½ Carbonate ½ Sulfate	Darks	0.53	8.09
	Seconds	0.51	8.18
	Both	**0.52**	**8.13**
⅓ Sulfate ⅓ Carbonate ⅓ Nitrate	Darks	0.57	7.97
	Seconds	0.51	8.32
	Both	**0.54**	**8.15**

It will be noted in this table that the most sulfur is found in the leaf when sulfate of potash is used as the source of potash. The least amount of sulfur is found when nitrate or carbonate are used. Increase in the sulfur content of leaves following increase in fertilizer sulfur has been noted in our previous experiments at this station (Bul. 10, p. 46) as well as by other investigators there mentioned. The differences in the potash content of the leaves are perhaps too small to be of importance.

CONCLUSIONS FROM ALL POTASH EXPERIMENTS TO DATE

1. There are about 35,000 pounds of potash per acre in the upper eight inches of soil on the experiment station farm. This soil is typical of a large part of the tobacco section.

2. This supply of potash is not sufficiently available to meet the needs of a tobacco crop and yearly additions of fertilizer potash are necessary.

3. When all potash is omitted from the fertilizer, the grading of the tobacco is affected, beginning with a decline the first year and rendering the leaves worthless in about three years.

4. Such leaves are thick, dry, non-elastic (boardy) yellow and of very inferior quality generally.

5. One hundred pounds of potash per acre is not sufficient to maintain the quality of the leaf.

6. Up to the present there has been no benefit from raising the quantity of potash to 300 pounds in the fertilizer.

7. Reducing the potash has not seriously affected the acre yield of tobacco.

8. It has had an injurious influence on the fire holding capacity.

9. Reducing the quantity of potash in the fertilizer has materially reduced the percentage of potash in the leaf.

10. The substitution of sulfate of potash-magnesia for high grade sulfate of potash has been of no advantage on the soil where tested but may be beneficial in preventing sand-drown in lighter soils.

11. Its use has lowered the grading and fire holding capacity. It has not increased the yield.

12. It increased greatly the magnesia content of the leaves but reduced the calcium and to a less degree, the potash.

13. It increased the sulfur content of the leaves.

In comparing sulfate, carbonate and nitrate of potash:

14. Carbonate gave the best grading but the lowest yield. It also gave the best fire holding capacity.

15. Nitrate was satisfactory from all standpoints but should not be used in excess on account of its high nitrate content.

16. Most consistently good results were secured from a combination of the three sources of potash, deriving one-third of the required potash supply from each carrier.

17. The quantity of potash absorbed has not been influenced by the carriers used.

18. The use of sulfate has increased the sulfur content of the leaves. The use of carbonate or nitrate gave a smaller quantity of sulfur in the leaves.

19. The reaction of the soil has not been changed perceptibly by using any of these carriers for four years.

20. Tobacco stems have also been a favorable source of potash for tobacco.

Effect of Fertilizers on the Combustion of Tobacco

In the Report of the Tobacco Station for 1927 (Tob. Sta. Bul. 10) an introductory article on this subject was published and all data on the crops of 1925 and 1926 were presented. The present report is a continuation of that account and gives results of burn tests on the crop of 1927.

When the Havana Seed crop of 1927 was sorted, sample hands of the four grades were taken from each plot, labelled and fermented for six to eight weeks in the sweat room of the W. S. Pinney warehouse in Suffield. The case of samples was left undisturbed to undergo a natural sweat at the warehouse until October, 1928 when it was taken to the Station where strip burn tests were made

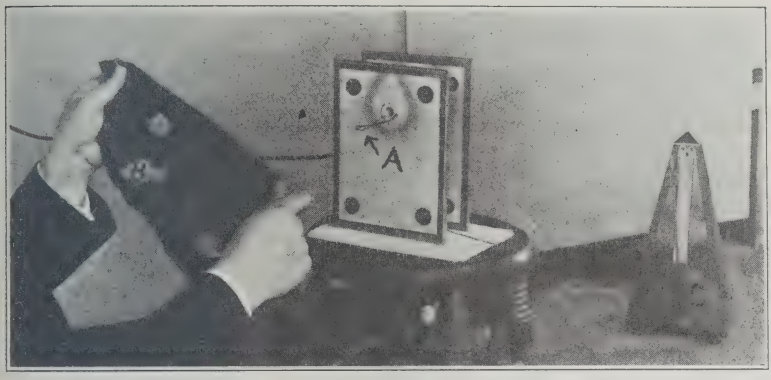

FIG. 16. Making strip tests on combustion. A, Electrically heated coil for ignition. B, Holes burned in leaf. C, Metronome for timing.

with an electrically heated filament. Five leaves were tested from each hand, each in four different places making a total of 20 tests from each hand. The leaves were just moist enough to handle well without breaking. The leaf was ignited near the midrib and held in such position that the flame progressed straight upward between the lateral veins. A metronome was used for counting and 60 seconds was considered the maximum, i. e., the count was stopped at 60 even though the leaf continued to burn.

The crop as a whole had an unusually long fire holding capacity. On most of the plots so many of the tests ran to 60 seconds that the averages showed only very small differences. The unusually long duration of burn—longer than any station crop yet tested—is probably due to the wet growing season of 1927.

THE POTASH SERIES

There are five series of potash plots, each of which will be discussed separately.

High Grade Sulfate of Potash vs. Double Sulfate of Potash-Magnesia. The crop of 1927 was the fifth consecutive crop raised on these six plots. Burn records for the two preceding crops are

recorded and discussed in Tobacco Station Bul. 10, p. 30. Burn records for the 1927 crop and three year average are presented in Table 19 below.

TABLE 19. SULFATE OF POTASH VS. SULFATE OF POTASH-MAGNESIA. STRIP BURN TESTS FOR 1927 CROP

Plot No.	Source of potash	Duration of burn in seconds						
		Darks	Mediums	Lights	Seconds	Ave. of all grades	Both plots	3 year average
K1	High grade	59.5	58.4	....	58.8	58.9	57.7	41.2
K1-1	sulfate	55.0	59.4	54.6	57.8	56.7		
K2	Sulfate of	59.9	58.8	....	52.6	57.1	56.7	36.6
K2-1	Pot. Magn.	52.1	56.7	57.3	59.2	56.3		
K3	One half	55.0	58.8	59.5	60.0	55.8	56.6	38.7
K3-1	from each	56.9	59.3	55.8	57.2	57.3		

The fire holding capacity of all grades on all six plots was very high and the differences are probably too small to be significant. Comparing the three year averages (each figure representing 480 tests) there appears to be a small but constant difference in favor of high grade sulfate. It is questionable whether this difference is sufficiently large to offer serious objection to the use of double manure salts.

TABLE 20. CARBONATE, NITRATE AND SULFATE OF POTASH. SERIES OF 1925. STRIP BURN TESTS FOR 1927 CROP

Plot No.	Source of potash	Duration of burn in seconds.						
		Darks	Mediums	Lights	Seconds	All grades	Ave. for treatment	3 year average
K1-2	Sulfate	58.2	54.3	56.6	48.3	54.4	52.6	44.2
K1-3		51.5	47.7	54.3	49.5	50.7		
K5	Carbonate	54.9	56.6	54.8	53.5	55.0	55.8	49.9
K5-1		58.0	49.8	59.6	59.3	56.7		
K7	⅔ Nitrate	55.5	55.5	48.1	57.2	54.1	53.1	45.9
K7-1	⅓ Carbon.	56.3	....	49.7	49.7	51.9		
K8	½ Sulfate	55.3	56.4	57.4	53.4	55.6	55.4	45.2
K8-1	½ Carbon.	53.5	56.9	56.7	53.9	55.3		
K9	⅓ Sulfate	59.6	50.2	50.1	58.8	54.7	55.4	47.8
K9-1	⅓ Carbon. ⅓ Nitrate	59.2	....	58.0	52.1	56.4		

Comparison of carbonate, sulfate and nitrate of potash. Ten of these plots were started in 1925, the other 22 in 1927. Burn tests on the series of 1925 are recorded in Bul. 10, p. 32. No previous report on the 1927 series has been made. Strip burn tests for the 1927 crop are presented in Table 20 and Table 21.

The results agree with those of the two previous years. The carbonate plots have a slightly higher fire holding capacity than the others while the sulfate tobacco is lowest. These differences, however, are quite small. It will be noted that the heavier grades have a somewhat longer fire holding capacity which in general is not in agreement with results of previous years. This is partly due to the fact that the light grade leaves were so thin that the line of fire consumed to the margin of the leaf before 60 seconds elapsed, thus lowering the average.

TABLE 21. CARBONATE, SULFATE AND NITRATE OF POTASH. SERIES OF 1927. STRIP BURN TESTS FOR 1927 CROP

Source of potash	Plot No.	Duration of burn in seconds					
		Darks	Med'ms	Lights	Seconds	All grades	Average for treatment.
Sulfate	K1-4	....	51.7	48.3	56.9	52.3	53.4
	K1-5	34.9	49.5	46.6	55.9	46.5	
	K1-6	57.8	55.8	47.3	58.5	54.8	
	K1-7	53.7	54.3	55.6	57.6	55.3	
	K1-8	55.1	56.9	....	....	56.0	
	K1-9	58.1	57.2	53.4	57.7	56.6	
Carbonate	K5-2	56.4	60.0	58.7	58.9	58.5	56.0
	K5-3	58.6	59.2	59.8	58.0	58.9	
	K5-4	51.9	52.8	46.9	51.2	50.7	
⅔ Nitrate ⅓ Carbonate	K7-2	59.0	....	51.7	58.0	56.2	56.2
	K7-3	55.8	57.7	55.2	54.6	55.8	
	K7-4	59.3	....	55.6	55.7	56.9	
½ Sulfate ½ Carbonate	K8-2	56.7	54.3	57.7	59.7	57.1	56.5
	K8-3	52.7	53.8	51.7	59.2	54.3	
	K8-4	56.3	59.9	56.8	59.3	58.1	
⅓ Sulfate ⅓ Carbonate ⅓ Nitrate	K9-2	51.2	54.6	47.0	57.5	55.1	55.4
	K9-3	53.9	51.3	56.9	54.8	54.2	
	K9-4	51.6	49.6	54.7	56.3	53.1	
	K9-5	57.3	57.7	55.8	59.5	57.6	
	K9-6	56.6	52.0	51.3	57.2	54.3	
	K9-7	52.6	56.1	58.3	58.6	56.4	
	K9-8	58.7	58.1	54.8	56.5	56.8	

As shown in Table 21, the fire holding capacity of the series of 1927 was somewhat the lowest on the sulfate plots but practically the same in all the others.

Tobacco Stems. In the 1927 series of potash plots, there were three plots which received all their potash from tobacco stems.

These were the N4 plots of previous years (1922-26) which received the largest application of sulfate of ammonia and consequently had the poorest burn (Bul. 10, p. 24). It is not unlikely that there was a carry-over effect from previous treatment and this should be kept in mind in judging the tests of at least the first year.

Results of the tests on the 1927 crop are presented in Table 22.

TABLE 22. STEMS PLOTS. STRIP BURN TEST ON CROP OF 1927

Plot No.	Duration of burn in seconds					
	Darks	Med'ms	Lights	Seconds	All grades.	Average for treatment.
K14	51.1	52.3	45.8	53.4	50.7	
K14-1	45.9	59.6	57.1	58.2	55.2	53.8
K14-2	56.5	55.9	52.5	57.5	55.5	

The average burn of all (53.8 seconds) is practically the same as for the adjacent sulfate of potash plots.

Quantity of potash. In order to determine the optimum quantity of potash which should be applied in the fertilizer, six plots were started in 1926. The 1927 crop was therefore the second one. Burn tests for this year, presented in Table 23, show that there has been a decided drop in fire holding capacity where no potash has been applied for two years but that otherwise 100 pounds per year has been just as effective as 200 pounds in keeping up the burning quality. Whether this will be true for a longer period of years is yet to be tested.

TABLE 23. QUANTITY OF POTASH, SERIES OF 1926. STRIP BURN TESTS ON THE 1927 CROP

Quantity of potash	Plot No.	Duration of burn in seconds.					
		Darks	Med'ms	Lights	Seconds	Average of All grades	Average of Both plots
None	K11	37.0	....	....	34.2	35.6	36.3
	K11-1	37.7	....	....	36.3	37.0	
100 lbs.	K12	57.1	58.8	57.1	58.4	57.8	57.0
	K12-1	55.6	53.8	55.9	60.0	56.3	
200 lbs.	K9	59.6	50.2	50.0	58.8	54.5	55.6
	K9-1	59.2	....	58.0	52.1	56.8	

Comparison of Table 23a with Table 23 shows that the reduction in fire holding capacity was not serious the first year.

TABLE 23A. QUANTITY OF POTASH; SERIES OF 1926. STRIP BURN TESTS ON THE CROP OF 1926

Quantity of potash	Plot No.	Duration of burns in seconds					
		Darks	Med'ms	Lights	Seconds	Average of All grades	Average of Both plots
None	K11	23.0	31.9	49.4	40.8	36.3	38.9
	K11-1	26.0	45.3	41.4	52.9	41.4	
100 lbs.	K12	22.0	46.4	50.6	40.6	39.9	39.9
	K12-1	18.1	35.9	57.2	48.8	40.0	
200 lbs.	K9	11.5	59.0	58.9	53.6	....	45.2
	K9-1	41.5	42.2	56.9	41.7	....	

In 1927 the series was extended by the addition of 18 plots on Field 1. Burn tests for the first year (presented in Table 24) show only a small reduction in fire holding capacity for the first year where all carriers of potash were omitted.

TABLE 24. QUANTITY OF POTASH; SERIES OF 1927. STRIP BURN TEST FOR 1927 CROP

Pounds of potash	Plot No.	Duration of burn in seconds					
		Darks	Med'ms	Lights	Seconds	Average of All grades	Average of Treatment.
None	K11-2	52.7	56.3	51.5	57.4	54.5	53.9
	K11-3	55.2	36.8	56.2	58.0	51.5	
	K11-4	53.6	60.0	60.0	54.4	56.5	
	K11-5	54.4	55.5	52.1	49.7	52.9	
	K11-6	53.6	52.5	58.1	55.1	54.8	
	K11-7	57.5	48.4	54.3	52.2	53.1	
100 lbs.	K12-2	49.7	....	58.5	58.3	55.5	57.2
	K12-3	53.9	60.0	58.6	58.8	57.8	
	K12-4	58.2	57.6	58.0	....	57.9	
200 lbs.	K9-5	57.3	52.7	55.8	59.5	57.6	56.2
	K9-6	56.6	52.0	51.3	57.2	54.3	
	K9-7	52.6	56.1	58.3	58.6	56.4	
	K9-8	58.6	58.0	54.8	55.5	56.7	
300 lbs.	K13	60.0	57.8	58.7	52.0	57.1	56.9
	K13-2	56.9	57.0	56.0	59.4	57.6	
	K13-3	58.5	55.0	55.5	....	56.3	
	K13-4	56.9	58.0	59.0	....	58.0	
	K13-5	51.0	58.0	57.8	57.1	56.0	

NITROGEN SERIES

In 1927 we had four sets of plots where nitrogen fertilizers were under comparison. Each is discussed separately below.

Urea plots. Burn tests for previous years on some of these plots were discussed in Bulletin 10, p. 29. Three plots received all their nitrogen from urea, three received one-half of their

nitrogen supply from urea, while three others, which received none of their nitrogen from urea, served as controls. Total quantity of nitrogen as well as the other food elements were the same on all.

Strip burn tests on the crop of 1927, presented in Table 25 below indicate a slight reduction in fire holding capacity when the entire nitrogen supply was from urea but there was no reduc-

TABLE 25. UREA PLOTS. STRIP BURN TESTS ON CROP OF 1927

Plot No.	Amount of urea	Duration of burn in seconds.						
		Darks	Mediums	Lights	Seconds	All grades	Treatment	3 year average
N1-5	None	53.6	58.8	55.8	56.4	56.3	57.7	33.1
N1-6		60.0	57.3	....	60.0	59.1		
N1-7		58.3	56.7	59.1	58.9	58.2		
N8	½ nitrogen from urea	58.9	56.3	57.7	59.9	58.2	57.1	34.1
N8-1		56.9	55.9	57.4	58.7	57.2		
N8-2		57.3	50.4	57.2	58.7	55.9		
N9	All nitrogen from urea	45.2	57.7	50.3	59.5	53.2	54.1	31.9
N9-1		53.1	55.4	55.9	58.6	55.8		
N14		52.6	59.8	53.5	47.3	53.3		

tion when one-half of the supply was from urea. The differences, however, are small and would probably not constitute serious objection to a full urea formula if it were desirable from all other standpoints.

Single sources of nitrogen. On these plots (started in 1926) six different nitrogen carriers, each used in turn as the only source of nitrogen in the formula, are under comparison. Tests of the previous year are discussed in Bulletin 10, pp. 26 and 60. The strip tests of the 1927 crop presented in Table 26, show that sulfate of ammonia gave the lowest fire holding capacity. In this and other

TABLE 26. SINGLE SOURCE OF NITROGEN PLOTS. STRIP BURN TESTS ON CROP OF 1927

Plot No.	Sources of potash	Duration of burn in seconds.						
		Darks	Mediums	Lights	Seconds	All Grades	Ave. of treatment	2 year average
N11	C. S. Meal	50.6	.....	.....	55.1	52.9	52.9	43.5
N12	Nitrate Soda	56.1	.....	.....	59.9	58.0	58.0	47.5
N13	Sulfate Am.	44.3	.....	.....	55.6	49.9	49.9	35.4
N14	Urea	52.6	59.8	53.5	47.3	53.3	53.3	41.2
N22	Nitr. Lime	55.2	.....	.....	59.7	57.5	.....	.....
N23	Nitr. Lime	55.4	.....	.....	59.7	57.5	57.5	.....
N24	Castor Pom.	57.7	.....	.....	59.7	58.7	58.7	.....

tests of the same year it has been noted that the depression of fire holding capacity from the use of sulfate of ammonia was not so pronounced as in the two previous years. The heavy rainfall of 1927 may have had an influence. The fire holding capacity of the nitrate of soda plot is very high again in 1927, as it was in the preceding year. The same was true of the nitrate of lime plots. All of these plots showed distinct signs of nitrogen starvation during the latter part of the wet growing season and the cured tobacco was of poor quality. The long fire holding capacity may be due to the absence of hindering nitrogen compounds in the leaf rather than to any specific effect of the nitrates of lime and soda. Contrary to the popular impression, castor pomace had no unfavorable influence.

Concentrated formula. The trend of recent years is toward a very concentrated fertilizer. This has obvious advantages provided the quality and yield of the crop are not adversely affected. The concentrated formula (18-14-18) described in Bul. 6, p. 16, was slightly modified in 1927 and was composed as follows:

CONCENTRATED FORMULA (PER ACRE)

Urea	286 lbs.
Nitrate of potash	250 lbs.
Carbonate of potash	129 lbs.
Carbonate of magnesia	31.3 lbs.

This extremely concentrated formula (28.5-0-28.5) contained no phosphorus because experiments on this field indicated no benefit from use of phosphorus.

Since no previous report on the burn tests of tobacco from these plots has been made, records for the crops of three years are presented in Table 27. There is a small reduction in fire holding

TABLE 27. CONCENTRATED FERTILIZER. STRIP BURN TESTS ON CROPS OF 1925-26-27

		Duration of burn in seconds													
		Darks			Mediums			Lights			Seconds			3 yr. ave.	
		1925	1926	1927	1925	1926	1927	1925	1926	1927	1925	1926	1927	Plot all Gr.	Treatment
3	Stand	49.3	9.7	54.4	48.1	23.3	59.9	49.4	56.8	59.2	56.1	52.4	59.0	48.2	46.8
4		49.0	9.9	50.9	42.1	33.0	58.4	41.9	45.9	59.4	48.1	49.0	57.9	45.5	
)	Conc	34.8	6.9	57.4	44.0	32.2	56.8	40.5	47.3	53.6	46.9	45.0	59.6	44.0	41.0
)-1		32.2	19.1	50.7	21.8	13.0	44.5	44.3	47.3	54.2	40.2	45.2	47.1	38.3	

capacity due to the concentrated formula. Since, however, it is not certain just which constituent of this fertilizer is responsible, one would not be justified in concluding that other concentrated mixtures would have the same effect.

Nitrate of soda *vs.* **nitrate of lime.** The object of this series of eight plots was to compare nitrate of soda with nitrate of lime as the source of mineral nitrogen of the fertilizer. In the first comparison one-fifth of the nitrogen was in mineral form, while in the second, one-half was in mineral form. The series was begun in 1927. Results of the burn tests of the first crop, presented in Table 28, indicate that the burn was excellent on all plots and there were no significant differences where the two kinds of nitrate were compared.

TABLE 28. NITRATE OF LIME PLOTS. STRIP BURN TESTS ON 1927 CROP

Plot No.	Nitrogen Source	Duration of burn in seconds					Average of treatment.
		Darks	Med'ms	Lights	Seconds	All grades	
N1-8	⅕ N. in	47.0	52.7	58.5	55.9	53.5	55.8
N1-9	Nitr. Soda	58.4	57.3	59.0	57.4	58.0	
N16	⅕ N. in	60.0	58.5	59.2	60.0	59.4	59.2
N16-1	Nitr. Lime	58.1	59.8	58.7	60.0	59.1	
N2-3	½ N. in	58.8	54.4	56.4	58.9	57.1	57.0
N2-4	Nitr. Soda	52.0	59.8	59.3	56.7	57.0	
N18	½ N. in	59.8	59.2	56.3	58.9	58.5	58.2
N18-1	Nitr. Lime	....	58.3	55.9	58.9	57.7	

LIME SERIES

Field VIII was heavily limed each year up to 1925. Since the soil was then found to have a reaction somewhat above neutral no more was applied. Strip tests on the crops of 1925 and 1926 are recorded in Bulletin 10, p. 33. Tests on the 1927 crop, recorded below in Table 29 agree with those of preceding years in showing a

TABLE 29. LIME PLOTS. STRIP BURN TESTS ON FIELD VIII TOBACCO COMPARED WITH NO-LIME PLOTS. CROP OF 1927

Plot No.	Lime treatment	Duration of burn in seconds					Treatment average
		Darks	Med'ms	Lights	Seconds	All grades	
L1	Lime	47.1	....	....	34.0	40.6	45.7
L2		....	....	....	54.6	54.6	
L3		46.0	....	....	43.5	44.8	
L4		55.3	42.6	....	42.7	46.9	
N1-5	No Lime	53.6	58.8	55.8	56.4	56.3	57.3
N1-6		60.0	57.3	....	60.0	59.1	

distinct reduction in fire holding capacity where lime is heavily applied.

On another series of plots on Field I where the effect of different fertilizers on black rootrot was being tested, one-half of each plot was heavily limed each year beginning with 1924. Burn tests for 1925 and 1926 were recorded in Bul. 10, p. 33. Those for the 1927 crop, given in Table 30 below, show some depressing effect of lime

TABLE 30. LIME PLOTS. STRIP BURN TESTS ON LIMED AND UNLIMED ENDS OF THE BLACK ROOTROT SERIES. CROP OF 1927

Plot No.	Lime treatment	Duration of burn in seconds					
		Darks	Med'ms	Lights	Seconds	Treatment Ave.	Three year Average
T1a	Lime	....	....	....	....	20.8	
T1ax		34.1	....	....	7.5		
T1b	No Lime	52.9	57.5	....	56.8	54.1	
T1bx		53.6	43.9	57.2	57.0		
T2a	Lime	....	....	....	34.2	43.9	
T2ax		55.4	....	....	42.3		
T2b	No Lime	60.0	....	....	58.8	58.9	
T2bx		60.0	59.4	56.3	58.7		
T3a	Lime	37.4	....	....	42.8	36.3	
T3ax		42.2	....	....	22.9		
T3b	No Lime	59.7	59.5	58.1	59.4	59.2	
T3bx		59.9	60.0	59.7	58.3		
Average of all lime plots						35.4	26.5
Average of unlimed plots						56.5	39.8

when measured by the strip test. In this table it will be noted that the acid fertilizer (T1) still further reduced the fire holding capacity. This effect, which is probably due to sulfate of ammonia, was also very evident in the preceding years.

Reasons for the depressing effect of lime are discussed on p. 198.

UNFERTILIZED TOBACCO

There are two small plots on the station farm where tobacco has been grown continuously since 1924 but without the addition of any fertilizer. The tobacco grown here has been short and very inferior, in fact, not worth harvesting. In order to see what effect the fertilizer as a whole has on burn, the crops of 1926 and 1927 were tested. The results, presented below in Table 31, show that

the fire holding capacity of this tobacco was just as inferior as the quality. This was probably due to the potash shortage because the plants in the field showed symptoms of shortage of this element and also because other tests have not shown such a depression from shortage of either nitrogen or phosphorus in the fertilizer.

TABLE 31. UNFERTILIZED PLOTS COMPARED WITH STANDARD FERTILIZED PLOTS. BURN TESTS ON CROPS OF 1926-27

Plot No	Fertilizer	Duration of burn in seconds								
		Darks		Mediums		Lights		Seconds		Average for treatment
		1926	1927	1926	1927	1926	1927	1926	1927	
Ntr1	None	4.6	....	5.4	....	....	....	7.2	....	16.4
Ntr 2		8.0	....	....	42.0	....	25.8	5.4	33.	
N1	Standard	10.6	....	16.2	....	39.8	....	44.0	....	37.1
N1-5		....	34.9	....	48.5	....	46.6	....	55.9	

INFLUENCE OF THE SEASON ON COMBUSTION

In making the fire holding capacity tests on the crop of 1927 it was observed that, irrespective of fertilizer treatment, all the tobacco had a much better fire holding capacity than the tobacco of the preceding year. In order to check on our impressions, an average of all burn tests on crops of the two seasons was calculated. The average of 7,460 tests for 1927 was 54.6 seconds as compared with an average of 27.4 seconds for 5,400 tests on the 1926 crop. Since the fertilizer treatment, except for a small number of plots, had been the same and the tests were made in the same way at the same time of year and under the same conditions, the conclusion seemed warranted that the difference was due to the season. Inquiry among tobacco dealers disclosed the general opinion among them that the crop of 1927 was an unusually free burning one.

When the weather records for the two seasons, as recorded at the station farm, were compared, the most apparent difference was found to be in rainfall. During the period from the application of the fertilizer to the last day of harvesting the rainfall in 1926 was 6.33 inches and in 1927 for the same period it was 13.26 inches, i. e., when the rainfall was doubled, the fire holding capacity was also doubled.

In order to see whether this same rule would apply to the preceding years, the rainfall for 1924 and 1925 was tabulated (Table 32) along with the average burn. As indicated in this table the correlation in the extremely dry year 1924 was about as anticipated, viz., extremely poor fire holding capacity. It is a matter of history well known to all dealers that the 1924 crop was the

poorest burning crop in many years. The correlation in 1925, however, is not so good, i. e., the fire holding capacity was lower than expected. This may be partially explained by the fact that some of the burn tests for that year were made before sweating the tobacco, and unsweat tobacco never burns as well, but even when allowances are made for this, it is apparent that the 1925

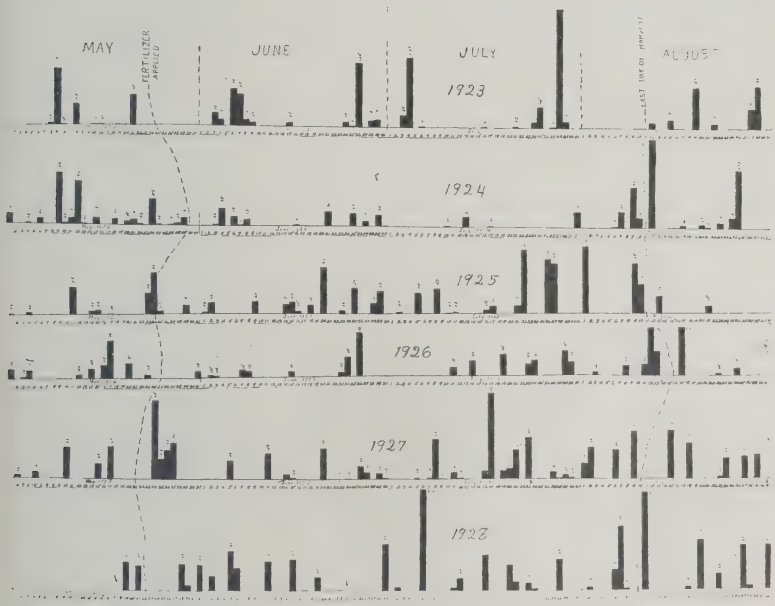

FIG. 17. Rainfall records during tobacco growing season for six years. Height of black column indicates amount of rainfall in one day.

TABLE 32. CORRELATION OF RAINFALL AND FIRE HOLDING CAPACITY

Year	Date of application of fertilizer	Last day of harvesting	Rainfall during this period	Average Fire Holding capacity	Number of test made
1924	June 1(?)	Aug. 12	3.57	9.2	720
1925	May 25	Aug. 10	12.02	32.1	4,360
1926	May 23	Aug. 16	6.33	27.4	5,400
1927	May 20	Aug. 10	13.26	54.6	7,460
1928	May 22	Aug. 10	12.66	.....	.....

crop did not burn so well as that of 1927. The explanation probably lies in the **distribution** of the rainfall particularly the time of

occurrence of leaching rains and a record of the leaching for each season might be instructive. Distribution of rainfall at the station in Windsor (supplemented where necessary by the U. S. Weather Bureau in Hartford) is presented in Tables 33, and Figure 4.

This same relation of rainfall to fire holding capacity has been observed by Haley and Olson (Rpt. Dir. Pa. Agr. Exp. Station for 1927). They explain it as due to the greater absorption of basic potassium, and the consequent increase in the water soluble alkalinity of the ash of the plant during seasons of high rainfall when the crop is maturing.

TABLE 33. DISTRIBUTION OF RAINFALL IN INCHES ON TOBACCO EXPERIMENT STATION FARM. 1922-28*

By 10 day Periods

Period	Year						
	1922	1923	1924	1925	1926	1927	1928
May 1–10	3.01	1.24	1.44	.08	.43	.83	.....
May 11–20	2.20	.45	1.35	.73	1.66	.97	.6
May 21–31	.21	.64	.91	1.55	.22	3.24	1.70
June 1–10	.87	2.05	.71	.49	.37	.39	1.62
June 11–20	1.38	.07	.01	1.61	.10	1.33	1.57
June 21–30	4.67	1.72	.90	1.28	1.39	.56	.97
July 1–10	2.28	1.77	.01	1.02	.....	.87	2.20
July 11–20	1.39	.01	.22	.27	.93	2.51	1.64
July 21–31	.89	3.24	.31	3.71	1.33	1.79	1.08
Aug. 1–10	.85	1.17	1.41	3.5	.26	2.57	1.88
Aug. 11–20	3.60	1.40	1.99	.35	2.73	1.77	3.18

By Months

Month	Year						
	1922	1923	1924	1925	1926	1927	1928
May	5.42	2.33	3.70	2.36	2.21	5.04	2.30
June	6.92	3.84	1.62	3.38	1.86	2.28	4.16
July	5.16	5.02	.54	5.00	2.26	5.17	4.92
Aug. 20	4.45	2.57	3.40	3.85	2.99	4.34	5.06

*Records of 1922-23-24 and May and June of 1925 from the Hartford Station of the U. S. Weather Bureau.

MAGNESIA HUNGER, OR SAND-DROWN

This malnutrition trouble has been more prevalent during the season of 1928 than any other year the writers recall. Many

growers who never saw it before are now quite familiar with it. In the field it has very distinct symptoms which are easy to diagnose after one has seen it a few times. The leaves fade out between the veins to a light yellow or almost white, contrasting strongly with the dark green pattern of the vein system. They do not crinkle or turn down at the margins, as is the case with potash hunger, but remain smooth and feel thick and stiff between the fingers. The lower leaves are affected first but afterward the symptoms may advance up the plant, even to the top leaves in extreme cases. In very advanced stages the yellow areas between the veins may die and turn brown. The most serious damage, however, comes from checked growth of the plant and the lifeless character of the cured leaves. On the sorting bench we have found these sand-drown leaves characterized by "double colors", a serious defect in tobacco. The areas between the veins which were yellow or white in the field now are either brick red or yellow, contrasting with the greenish brown of the remainder of the leaf.

The trouble occurs only during the years of heavy rainfall and almost always on porous sandy parts of the field where leaching may be expected. Hence the popular name, "sand-drown".

The malady is caused by the inability of the tobacco plant to get from the soil its required amount of magnesium, an element which is just as essential to the proper development of tobacco as nitrogen, phosphorus or potassium. Like salt for the human being, a very small amount will suffice but it is absolutely essential. The fact that in Connecticut we have rarely been troubled with magnesia shortage is due to its presence, in small amounts, in other ingredients of the fertilizer. Unintentionally we have been giving the plant a sufficient ration for ordinary seasons in cottonseed, castor pomace, linseed, stems, manure and the like. All vegetable organic fertilizers contain small quantities of magnesia. Until the present year we have never observed sand-drown on our station plots where we used as much as a ton of cottonseed meal or a ton of combined meal and pomace per acre. But the occurrence of heavy rains for two years in succession has apparently so depleted the available supply of magnesia that in 1928 we have found trouble even under these conditions on light land. Another possible explanation of its prevalence in 1928 may be the *frequency* of leaching rains during the growing season resulting in constant removal of the magnesia as fast as it came into solution.

The substitution of concentrated synthetic products for a part of the vegetable organics may have made the trouble more wide spread this year, since these materials contain little if any magnesia. At the station we observed sand-drown to be worst where sulfate of ammonia was the only source of nitrogen. It is probable that the sulfate united with the magnesia and in this very soluble form was leached away. This would account for the severity of the trouble immediately after heavy rains. It was also quite common

on the nitrate of soda and nitrate of lime plots. Where a large part of the nitrogen was in urea it was also common in 1928 but not in 1927 and never so severe as on the sulfate of ammonia plots.

The obvious remedy lies in putting more magnesia in the fertilizer ration. Up to the present year we have thought that 15 pounds of magnesia per acre—about the amount in a ton of

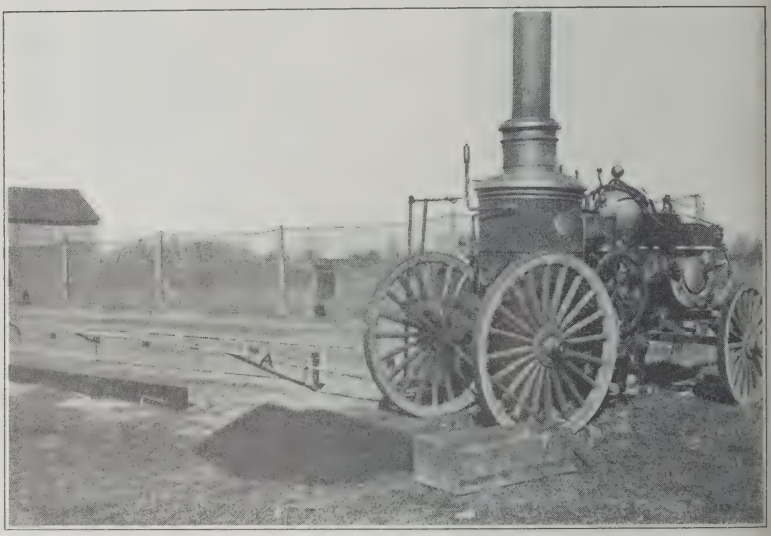

FIG. 18. Steam sterilizing the seed beds with the antiquated town fire engine. Soil can be sterilized to a depth of six inches in 20 minutes with this outfit. Steam supply line at A goes to pan.

cottonseed—was sufficient. As a matter of precaution against the unusual year, however, it may be a good policy for those who have observed this trouble or who have unusually sandy land to add more—perhaps double the dose.

There are a number of materials which may be used. Magnesian lime or limestone (dolomitic limestone) may be applied to lands which are acid enough to stand it. A hundred pounds of double manure salts contain 10 to 12 pounds of magnesia. Cottonhull ashes contain about the same amount. Wood ashes or other vegetable ashes contain a somewhat smaller but valuable supply. A ton of stems contains about 10 pounds.

The Effect of Sulfur, Ammonium Sulfate, and Aluminum Sulfate on the Reaction of Soils

In previous work at the Tobacco Station in Windsor (Tobacco Station Bulletins 6 and 8) it has been shown that on account of the danger of black rootrot it is desirable to keep tobacco soils fairly acid. The safety point was determined to be near 5.6 pH. Soils less acid than this (above 5.6 pH), especially during cold wet summers, are favorable to black rootrot.

On many tobacco soils where lime and wood ashes have been used too freely the reaction has reached a point far beyond the limit mentioned, i. e., too alkaline, to produce a good crop of tobacco. Hence, it would be beneficial to the grower if some method could be found to increase the acidity of such soils. With this in mind the present investigations were made.

Numerous workers (see Bul. 189 of Rhode Island station with extensive references and Tobacco Station Bul. 10) have found that ammonium sulfate increases the acidity of soils. Doran (2), Hibbard (3), de Long (6), Lipman and co-workers (4, 5), Simon and Schollenberger (7) also found that sulfur caused considerable increase in acidity.

Aluminum sulfate is found to be useful in controlling soil reaction as reported by Amsler (1). To what extent, however, the reaction is affected is not mentioned.

LABORATORY EXPERIMENTS*

In preliminary tests, where 100-gram samples of sandy soil were used, sulfur (fine powder) applied equivalent to 200 pounds per acre, decreased the pH value about one-half unit. The results were corroborated with similar treatments on 500-gram samples of the same soils. The equivalent of 500 pounds of sulfur per acre caused a decrease of about one unit. Increased application of sulfur did not seem to decrease the pH value correspondingly. This preliminary test seemed to indicate that an application at the rate of 500 pounds per acre would be the optimum quantity for an optimum increase in acidity.

Another set of laboratory experiment was made in which three different kinds of soil were used and having the following original pH values:

Clay soil	6.27
Organic soil	6.25
Sandy soil	5.42

*Credit is due to Dr. A. B. Beaumont, Mass. Agr. College, for suggesting the laboratory phases of this work.

As previously, 100-gram samples of these various soils were made up to furnish four non-treated and triplicates of the following treatments:

		Pounds per acre			
1.	Sulfur.....	250	500	750	1000
2.	Ammonium Sulfate....	1032	2060	3090	4120
3.	Aluminum Sulfate.....	1732	3465	5197	6930
4.	Sulfur.....	500	500	500	500
	Ammonium Sulfate....	1030	2060	3090	4120
5.	Sulfur.....	500	500	500	500
	Aluminum Sulfate.....	1732	3465	5197	6930

The amount of sulfur represents low, medium, high, and very high applications Ammonium sulfate and aluminum sulfate are taken in chemically equivalent amounts of sulfate, i. e., in the first three treatments the quantities of sulfur is the same in the various applications. In treatments 4 and 5, combinations of sulfur with the other materials, 500 pounds of sulfur has been taken as a medium constant amount of sulfur to use together with the other two materials.

The samples were kept at normal moisture (most suitable for growing conditions) during the course of the experiments. Reactions were determined electrometrically after four and eight weeks and the results are recorded in Tables 34, 35 and 36. Abbreviations used in the tables are:

S =Sulfur
AlS =Aluminum Sulfate
AmS =Ammonium Sulfate
1, 2, 3, 4, =low, medium, high, and very high applications of the various treatments.

Influence of treatments on clay soil. From Table 34 it is seen that the original pH value of the clay soil was 6.27 (the figure in parenthesis). Receiving nothing but distilled water, the pH had decreased to 5.84 after four weeks and to 5.82 after the lapse of eight weeks, thus showing practically no change after the first decrease. In this case sulfur had apparently been oxidized, although not added. Simon and Schollenberger (7) in sulfofication studies obtained a similar result in a field test, where no sulfur was supplied. They report that the acidity was increased by 0.4 pH as compared with 0.45 obtained in the results above. In computing the actual decrease in pH values, it seemed most reasonable to consider the difference between the value of the checks after eight weeks and those of the various treatments after the same time interval.

Applying *sulfur* at a rate of 250 pounds per acre decreased the pH by 0.48; 500 pounds of sulfur gave exactly the same results in four weeks, but at the end of eight weeks the difference between the two applications was hardly significant, since the actual decrease in the latter case was 0.54. Applying 750 pounds did not seem to work as quickly as the previous treatment, but had decreased the pH by 0.65 at the end of eight weeks. A similar result was obtained in four weeks by an application of 1,000 pounds per acre, which after eight weeks had caused a decrease of 0.74.

ABLE 34. REACTIONS OF CLAY SOIL TREATED WITH SULFUR, ALUMINUM SULFATE AND AMMONIUM SULFATE AFTER FOUR AND EIGHT WEEKS

reatments	Average pH of triplicate treatments			Treatments	Average pH of triplicate treatments		
	After 4 weeks	After 8 weeks	Decrease in pH		After 4 weeks	After 8 weeks	Decrease in pH
ck (6.27)	5.84	5.82	0.45				
1	5.77	5.34	0.48				
2	5.36	5.28	0.54	Combined	Treatme	nts	
3	5.50	5.17	0.65				
4	5.22	5.08	0.74				
S1	5.47	5.15	0.67	S+AlS1	5.23	4.95	0.87
S2	5.17	5.20	0.62	S+AlS2	5.09	4.96	0.86
S3	5.15	5.07	0.75	S+AlS3	4.86	4.83	0.99
S4	4.76	4.84	0.98	S+AlS4	5.24	5.11	0.71
S1	6.16	5.38	0.44	S+AmS1	5.33	4.97	0.85
S2	5.72	5.44	0.38	S+AmS2	5.22	4.86	0.96
S3	5.68	5.41	0.41	S+AmS3	5.31	4.98	0.84
S4	5.76	5.37	0.45	S+AmS4	5.41	4.89	0.93

An application of *aluminum sulfate* at a rate 1,732 pounds per acre resulted in a decrease of 0.67 after eight weeks. The same result was obtained in four weeks when 3,465 pounds were used. At the end of eight weeks, however, the total decrease of the latter treatment did not quite measure up to the result obtained by the lower application. Applying at a rate of 5,197 pounds showed about the same result as for 3,465 pounds, although the final results showed a decrease of 0.75. The highest application of aluminum sulfate (6,930 pounds) decreased the pH value by more than a unit after four weeks, after which time the maximum decrease apparently was reached as the values increased after the lapse of eight weeks, making the final result 0.98.

Using 500 pounds of *sulfur* in *addition* to the various applications of *aluminum sulfate*, the same relationship seemed to occur between the individual treatments, with exception of the highest application which markedly deviated from the rest. The sulfur added, on the average caused a decrease in pH values of about 0.2 unit below the aluminum sulfate alone at various applications

save the maximum application. Unless some error in the procedure unnoticed crept in, it is hard to explain that the highest application showed a lower result than the lowest amount applied, or 0.87 as compared with 0.71 pH decrease after eight weeks.

With respect to ammonium sulfate the various amounts applied did not show significant differences in results after eight weeks as the average decrease after this time was close to 0.40. Sulfur added to the treatments about doubled the effect, but showed the same general trend.

The ammonium radical in these cases may have had a buffering effect, as very little ammonia could have escaped during the experiment.

Influence of the treatments on the organic soil. In Table 35 the results from the various treatments on the organic soil are listed. It is shown that the original pH value of this soil, 6.25, after four weeks was 6.12 and after eight weeks 5.59. Here the untreated soil had turned more acid than the clay soil.

With respect to the various treatments, 250 pounds of *sulfur* had practically no desirable effect on the reaction; 500 pounds a very slight effect and 750 pounds were able to decrease the pH value only 0.3, and the highest application, 1,000 pounds, 0.55 pH.

On the other hand, *aluminum sulfate*, applied at a rate of 1,732 pounds per acre decreased the pH value by 0.38 after eight weeks. The double amount, however, was not more effective, neither was the next higher application. Using the rate of 6,930 pounds, caused a decrease of 0.85 after four weeks, but the total decrease after eight weeks amounted to practically the same as for the lowest application.

TABLE 35. REACTIONS OF ORGANIC SOIL, TREATED WITH SULFUR, ALUMINUM SULFATE AND AMMONIUM SULFATE, AFTER FOUR AND EIGHT WEEKS

Treatments	Average pH of triplicate treatments			Treatments	Average pH of triplicate treatments		
	After 4 weeks	After 8 weeks	Decrease in pH		After 4 weeks	After 8 weeks	Decrease in pH
Check (6.25)	6.12	5.59	0.66				
S1	6.18	5.70	0.00				
S2	5.92	5.51	0.08	Combined	Treatments		
S3	5.65	5.29	0.30				
S4	5.46	5.04	0.55				
AlS1	5.77	5.21	0.38	S+AlS1	5.44	5.04	0.5
AlS2	5.74	5.32	0.27	S+AlS2	5.37	5.20	0.3
AlS3	5.65	5.28	0.31	S+AlS3	5.22	5.03	0.5
AlS4	5.27	5.18	0.41	S+AlS4	5.79	4.83	0.7
AmS1	5.80	5.65	0.00	S+AmS1	5.19	5.18	0.4
AmS2	5.67	5.53	0.06	S+AmS2	5.24	5.12	0.4
AmS3	5.75	5.04	0.55	S+AmS3	5.30	4.99	0.6
AmS4	5.77	5.08	0.51	S+AmS4	5.53	4.94	0.6

FIG. 19. Steam pan in position. A, Pan; B, Steam supply line; C, Cross bars for lifting pan; D, Sides of seed beds. Steam beyond pan is rising from soil from which pan has just been removed.

It is interesting to note that although *sulfur*, added to the various applications of *aluminum sulfate*, considerably increased the acidifying effect, the relation between the individual treatments is somewhat similar to that of aluminum sulfate alone.

The lowest two applications of *ammonium sulfate* had practically no effect on the reaction after eight weeks, while the two higher ones caused a decrease of about half a unit in the same time.

Sulfur added to the various applications of ammonium sulfate caused a decrease of about 0.40, while at the two highest applications the decrease below the results from ammonium sulfate alone was hardly 0.1 of a unit.

Influence of the treatments on sandy soil. Of the three soils included in this study, the sandy soil untreated having an initial pH value of 5.42, had increased in acidity the least, only 0.17 after eight weeks. This soil, being relatively poor in content of buffering substances, showed the largest response to the various treatments, as may be seen in Table 36.

Sulfur at the lowest application resulted in a decrease less than half a unit pH, but doubling the application, more than doubled the decrease. Although further decreases were noted at higher applications, they were not in proportion to the materials supplied.

TABLE 36. REACTIONS OF SANDY SOIL TREATED WITH SULFUR, ALUMINUM SULFATE AND AMMONIUM SULFATE ATFER FOUR AND EIGHT WEEKS

Treatments	Average pH of triplicate treatments			Treatments	Average pH of triplicate treatments		
	After 4 weeks	After 8 weeks	Decrease in pH		After 4 weeks	After 8 weeks	Decrease in pH
Check (5.42)	5.47	5.25	0.17				
S1	5.18	4.82	0.43				
S2	4.87	4.31	0.94	Combined	Treatments		
S3	4.84	4.17	1.08				
S4	4.74	4.00	1.25				
AlS1	4.95	4.60	0.65	S+AlS1	4.83	4.33	0.92
AlS2	4.66	4.62	0.63	S+AlS2	4.58	4.30	0.95
AlS3	4.42	4.37	0.88	S+AlS3	4.29	4.01	1.24
AlS4	4.11	4.12	1.13	S+AlS4	4.15	4.00	1.25
AmS1	4.86	3.94	1.31	S+AmS1	4.86	4.25	0.99
AmS2	4.94	4.08	1.17	S+AmS2	4.94	4.30	0.95
AmS3	5.01	4.61	0.64	S+AmS3	5.01	4.29	0.96
AmS4	5.11	4.32	0.93	S+AmS4	5.11	4.23	1.02

The low and medium applications of *aluminum sulfate* seemed to have about equal effect after eight weeks. With the two higher applications the actual decrease was reached after the first four weeks as after this time the reaction was not markedly changed.

Adding sulfur to the treatment of *aluminum sulfate* had a marked effect at the low, medium and high applications. The highest application caused a decrease about similar to the high one after eight weeks.

The low application of *ammonium sulfate* to this soil resulted in the largest decrease in pH value recorded in this experiment as a whole. Doubling the application, however, did not measure up to the effect of the former and trebling the low application had only half of the effect of this one, while the effect of the highest application falls between these two.

On the other hand, when *sulfur* was added to the various applications of *ammonium sulfate* the effect was not nearly so great as in the case of the two first applications of ammonium sulfate alone, but instead the sulfur added seemed to balance the reaction, so as to give about equal effect of the four treatments.

Discussion of results from laboratory experiments. In the preliminary study it was found that sulfur applied at a rate of 500 pounds per acre would be about the proper amount to cause an optimum increase of acidity in sandy soils. As a similar result was obtained on the sandy soil in a later experiment, it seems reasonable to assume that in this case 500 pounds of sulfur would best serve the purpose of increasing the acidity.

No optimum application of sulfur could be established for the clay soil or the organic soil as the increased acidity quite uniformly corresponded to the amounts applied. Results from sulfur treatments in Tables 34 and 35 may thus serve as an indication of the difficulties that occur in highly buffered soils. The fact, emphasized by Lipman and co-workers (8), that sulfur is oxidized more rapidly in the absence of organic matter may also have played an important part in case of the organic soil. In general, however, the buffer action of this soil is prominent for all of the treatments used.

The results obtained with ammonium and aluminum sulfate and the combinations of these with sulfur, considering the large quantities used, do not favor a competition with sulfur alone for any of the soils used. The important factor of leaching was entirely eliminated in these experiments. A field study of the treatments discussed is thus needed to justify recommendations for practical purposes.

FIELD EXPERIMENTS

Field experiments on soil acidification by the use of sulfate of ammonia and inoculated sulfur were made in co-operation with the Hartford County Farm Bureau. The experiment was begun in the spring of 1927. Three fields were chosen where the reaction

was known to be nearly or quite neutral. Eight plots, each 2 x 4 rods (1/20 acre) were measured and treated as follows:

Plot 1. No sulfate of ammonia or sulfur.
3. 300 lbs. sulfate of ammonia per acre
3. 500 lbs. " " "
4. 800 lbs. " " "
5. 200 lbs. inoculated sulfur
6. 400 lbs. " "
7. 600 lbs. " "
8. 800 lbs. " "

In applying the fertilizer, the nitrogen of the formula was reduced on the sulfate of ammonia plots so that each of the eight plots received the same amount of nitrogen. On the 800 lb. plot only 500 lbs. were applied at first, the 300 being applied to the crop later.

Location of fields and times of application in 1927 were as follows:

1. Farm of R. E. Distin, Unionville. Field not previously in tobacco. Chemicals applied on June 13th. Land had previously had a heavy coat of manure. The soil showed a content of 7.43% organic matter. Plot 8 received the second application of sulfur on July 11th.

2. Farm of E. H. Sloan, Broadbrook. Field many years in tobacco; content of organic matter, 6.18%. Chemicals applied on June 8th. Second application on July 11th.

3. Farm of W. G. Phelps, Glastonbury. Old tobacco field; had a content of 6.72% organic matter. Chemicals applied on June 2d. Second application July 11th.

Organic matter was determined by Mr. Jacobson of the Station Soils Department.

At the time of the second application of sulfate of ammonia no differences in growth could be observed; neither were consistent

TABLE 37. REACTIONS OF SOILS TREATED WITH SULFATE OF AMMONIA AND SULFUR

Plot No.	Lbs. chemicals per Acre		Reaction of soil in the fall (pH)					
	Sulfate of ammonia	Inoculated sulfur	Sloan		Phelps		Distin	
			1927	1928	1927	1928	1927	1928
1	0	...	6.58	6.62	6.21	6.00	6.34	6.03
2	300	...	6.73	6.86	5.77	5.77	6.37	6.18
3	500	...	6.58	6.79	5.70	5.60	6.28	6.18
4	800	...	6.56	6.69	5.61	5.40	6.35	6.10
5	...	200	6.18	6.18	5.99	6.01	6.11	6.00
6	...	400	6.07	6.01	6.10	5.67	5.96	6.00
7	...	600	5.83	5.93	5.79	5.60	5.70	5.77
8	...	800	5.81	5.77	5.87	5.50	5.66	5.93

differences noticed later in the season. Therefore, the tobacco was not kept separate at time of harvest.

On May 9th and 10th in 1928 all the plots were treated as in previous year and chemicals applied all at one time before plowing. Also in the growing season of 1928 no differences in growth could be observed between the various treatments.

Both in the late fall of 1927 and 1928 soil samples were taken from the different plots and their reactions determined electrometrically. The results are presented in Table 37.

In regard to the effect of the chemicals on soil reaction a glance at Table 37 shows that sulfate of ammonia did not increase the acidity on the Sloan and Distin farms but had some effect on the Phelps farm. On the other hand, inoculated sulfur in every case increased the acidity. However, it is also apparent that continued applications of sulfate of ammonia and sulfur do not increase the acidifying effect. With respect to sulfur, the optimum effect seems to fall between 400 and 600 pounds per acre which is in fairly good agreement with the laboratory tests, previously discussed. The high content of organic matter in all these soils is probably one reason why they were so slightly affected by the treatments.

In order to observe the effect of aluminum sulfate adapted to field conditions, two 1/80 acre plots were laid out on a field* at the Tobacco Station in Windsor in the spring of 1928. In addition to general fertilizers the plots each received aluminum sulfate at a rate of 250 lbs. per acre. During the growing season no significant difference in the growth of tobacco was observed between these and adjacent check plots.

Reactions of the soil was determined in the spring before applying sulfate and in the fall after harvest and were as follows:

Adjacent check	Spring	5.77 pH	Fall	5.70 pH
Plot 1.	"	5.77 "	"	5.38 "
Plot 2.	"	5.72 "	"	5.17 "

This relatively low application of aluminum sulfate was thus able to increase the acidity considerably.

Discussion of results from field experiments. The use of sulfur, ammonium sulfate and aluminum sulfate has been tried out under field conditions. Sulfur has increased the acidity in all instances, the optimum effect being obtained by applications between 400 lbs. and 600 lbs. per acre. On the average, 500 lbs. of sulfur will cause a decrease in acidity of about 0.5pH. On many soils, however, a decrease of only 0.2 to 0.3 pH would be beneficial in order to approach the safety point from black rootrot. Laboratory as well as field tests have shown that up to 500-600 lbs. of sulfur per acre the acidity increases rather uniformly with the amounts

*Classified by the Soils Dept. as Merrimac loamy coarse sand.

applied. Hence there is no object in applying more sulfur than needed, especially since it is shown that sulfur may impair quality and burn, as discussed in Tobacco Station Bulletin 10.

The same bulletin also contains data on the use of ammonium sulfate in fertilizer for tobacco. An extensive use of sulfate of ammonia injures the burn, hence it should be used cautiously. Its greatest effect as acidifying agent would be on sandy soils, low in organic matter and also where lumps of limestone are not visible in the surface soil.

As for aluminum sulfate, its use still being in the experimental stage, no recommendations can be made at this time. However, since this chemical is now put on the market as a comparatively inexpensive product it may be advisable to make trials on a small scale, using up to 500 lbs. per acre.

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Summary of Progress on Projects

There are a number of lines of investigation on which distinct progress has been made during the year but which cannot be discussed in detail in the present report. These are briefly summarized below without citation of supporting data. They will be presented more completely in later publications.

Urea and calurea as sources of nitrogen in the fertilizer

Results of urea tests during three years have been reported in previous bulletins from this station. Results for 1928 are in line with those of the preceding three years. When one-half of the nitrogen of the formula is derived from urea the resulting yields and quality have been just as satisfactory as for a standard formula in which four-fifths of the nitrogen is from cottonseed meal and castor pomace. When all the nitrogen is from urea the tobacco is

not of such good quality. Sand-drown also affected the all-urea plots. More recently, another urea compound, calurea has appeared on the market and experiments were begun with calurea in 1928. Calurea has 4/5 of its nitrogen from urea and the other 1/5 from calcium nitrate. Tests of one year on calurea are in line with the results from urea. It is a less expensive source of nitrogen than urea because of the high import duty on the latter. Nitrogen in both of these carriers is quickly available and has shown no signs of serious leaching. In this form, nitrogen costs less than half of what it does in cottonseed meal and is much less bulky in handling. Up to the present there has been found no good reason why these cheaper synthetic products should not be used to supplant a part of the more expensive vegetable organic constituents of the fertilizer, but more data are needed before definite recommendations can be made.

NITRATE OF LIME AS A SOURCE OF MINERAL NITROGEN

It is a generally recognized principle that the tobacco fertilizer mixture should have a minor part of its nitrogen in a mineral carrier. The purpose of this is to furnish nitrogen in a quickly available form and thus function as a "starter" when the plants are first set in the field. Nitrate of soda is most extensively used for this purpose because of the immediately available nitrate it contains and because it is cheap and always plentiful on the market. Two objections to the use of nitrate of soda are: (1) during heavy rains the nitrogen in it leaches away very quickly, and (2) the sodium which it contains may raise the soil reaction. We have shown elsewhere that it causes the soil to become alkaline.

Within recent years, another quickly available mineral nitrate, nitrate of lime (calcium nitrate), has come into the market as a competitor of nitrate of soda. This material contains the same amount of nitrogen as nitrate of soda, is just as reasonable in cost (quoted somewhat lower in 1927 and 1928) and otherwise is very similar to nitrate of soda. It has the disadvantage of being somewhat more deliquescent than nitrate of soda. In our experience of 1927-28 we have not found that this property has caused the mixture in which it was used to "cake" or become lumpy even when it was used to supply as much as one-half of the nitrogen and permitted to stand for six weeks after mixing. It is marketed in paper-lined bags to prevent its becoming over-damp or hard during storage. From a theoretical standpoint it should be more suitable for use on tobacco because it contains calcium which is used in large amount by the tobacco crop and because calcium salts are known to give a desirable white color to the ash.

These two materials have been tested side by side for two years on the station farm deriving, (1) 1/5 of the nitrogen from these mineral sources and (2) ½ of the nitrogen from them. Averaging

the results of the two years we find no significant differences between them in yield, grading, or fire holding capacity. There appeared to be serious leaching of the nitrogen from both when they were used to supply one-half the fertilizer nitrogen. There did not seem to be any great difference between them in this respect. When the soil was tested one year after starting the series, the nitrate of soda plots were slightly more alkaline than the nitrate of lime plots. Cigars from these plots have not yet been tested; hence we have no data as to the effect of each on ash color.

COMPARISON OF SINGLE NITROGEN SOURCES

Results on this series in 1928 were about the same as for 1927 (fully reported in Tob. Sta. Bul. 10, p. 60). The four sources tested at station farm were cottonseed meal, nitrate of soda, sulfate of ammonia and urea. All fertilizer was applied at one time before setting. The nitrate of soda leached so badly that the tobacco made less than half a crop and on the sorting bench was of such inferior quality it was not fit to sort. Besides nitrogen starvation it also showed severe sand-drown. Fire holding capacity, however, was excellent—possibly because of absence of hindering nitrogen compounds. Nitrogen also leached seriously from the cottonseed meal plots, growth was checked and the cured tobacco was yellow and lifeless. It was considerably better than the nitrate of soda tobacco, however. Fire holding capacity was good but was surpassed by nitrate of soda. The sulfate of ammonia plot showed no signs of nitrogen starvation but remained rank and green except for sand-drown which was especially prevalent here. The yield was highest of all the plots but the quality was poor because of the double colors previously mentioned. Fire holding capacity was less than that of the other plots. No leaching of nitrogen was apparent on the urea plot but there was considerable sand-drown. Growth was good, yield being only slightly less than that of sulfate of ammonia. The quality was best of all these four plots.

Monthly soil tests which have been made for a year on these plots show little change in the cottonseed meal plot; the nitrate of soda plot is progressively more alkaline, the sulfate of ammonia plot is the most acid, the urea plot is progressively slightly more acid than the cottonseed meal plot.

MANURE AS A SUPPLEMENT TO COMMERCIAL FERTILIZER

The 1928 tests confirm those of 1927 (fully discussed in Tob. Sta. Bul. 10, p. 62). The tobacco remained greener and somewhat larger in the field than on adjacent unmanured plots. On the sorting bench it was found to have a better grade index and higher

yield. This was true both for stable manure and for artificial Adco manure. The differences, however, were not large.

FRACTIONAL APPLICATION OF NITROGEN

This experiment was continued on the same six plots as in 1927 (Tob. Sta. Bul. 10, p. 57). The extremely wet year was favorable for this kind of a test. One-half of the quickly available nitrogen (in nitrate of lime and nitrate of potash) was deducted from the

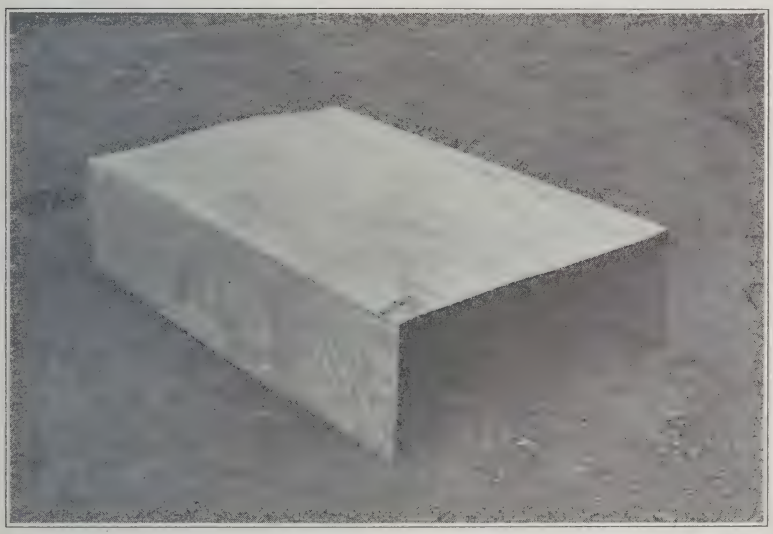

FIG. 20. Metal Fire Cover for spreading the heat.

first (broadcast) application and divided between two later applications. The second application (delayed by mistake) was made on July 2. On July 5 there was a heavy rain (over 2 inches) which caused serious leaching. The last application was therefore made on July 7. Within a few days the yellow color of the check plots showed that they did not have sufficient nitrogen. The fractional plots remained green. On the sorting bench the tobacco from the check plots was found to be yellow and lifeless, much inferior to the fractional plots. The yield was also less. The benefit from fractional application was unquestionable in 1928. This is the first year this has been true. It may be due to the fact that the later applications were made at exactly the critical time with respect to the heavy rains. The only objectional quality noted in the tobacco from the fractional plots was that the veins were

somewhat prominent. This soil is very sandy and subject to easy leaching.

These results and the observations on many other fields in 1928 show that if later nitrogen applications are to be used, they should be made *immedately* after the heavy rains *before* any fading of the leaves appears. Delay until the leaves appear yellow results in checked growth from which the plant never entirely recovers and reduced yield results.

COVER CROP TESTS

Records for 1928 show that every cover crop used both increased the yield and improved the grading of the tobacco grown on it. Rye gave the highest yield closely followed by vetch and oats. These three also had the best grade index. Timothy, barley, red-top, alfalfa and wheat were not so beneficial as the others but were better than no cover.

ROOTROT RESISTANT STRAINS OF TOBACCO

Experiments have been continued with resistant strains of Havana Seed, Broadleaf and Shade Cuban.

Wisconsin Havana No. 142 has again been shown to be highly resistant to Black Rootrot and it produces a heavier yield of leaf than any of the ordinary Connecticut Havana Seed strains. On account of the thinner, larger leaves, set closer together on a larger stalk this appears to suffer more than the others from pole sweat. In setting this type it would be advisable to increase the distance between plants in the row by at least two inches. Packers and manufacturers do not agree among themselves as to the merits of this as compared with the ordinary Havana Seed strains.

Broadleaf tobacco is not as susceptible to rootrot as the other two types but still the reduction in yield from this cause is so serious on some fields that a resistant strain is much needed if one that is desirable from other standpoints could be found or developed. One promising strain has been under test on the station farm for the last two years. Compared with the John Williams strain it yielded more leaf and the quality appeared as good. It seems to be more subject to pole sweat, however, possibly on account of thinner leaves and unusually large succulent stalks. Tests have not been conducted long enough to state whether it will meet the requirements of the trade. It is undoubtedly much more resistant than the John Williams type.

In 1927, in a shade field which was badly dwarfed from black rootrot, fifteen scattered plants were found which were making perfectly normal growth. Seed was saved separately from each of these. After harvest, the roots of these and many adjacent

plants were examined and relatively few lesions were found on these while the others about them were severely rotted. A row was planted from the seed of each one of these plants in 1928 and compared with alternate rows from common Cuban seed. Root-rot was not very severe on this field in 1928 and the contrast was not as marked as could be desired. Nevertheless it was apparent both from the growth and from the condition of the roots that some of these had considerably more resistance than the common Cuban plants. Further selections and tests are necessary and it is hoped that a satisfactory Cuban resistant strain may be secured from this chance find. Other resistant Cuban strains from another source are also under test but it is too early to predict what the results will be.

TOPPING AND SUCKERING EXPERIMENTS

Results of three years experiments at the station on these practices have just been published by N. T. Nelson as Bul. 297 of the Connecticut Agricultural Experiment Station.

FIRE CURING OF STALK TOBACCO

The importance of curing tobacco by charcoal fires is so fully recognized by the growers of shade tobacco that the practice is universal among them. The stalk tobacco growers, however, are inclined to "take a chance" on the weather and only a few of them practice charcoal firing.

Therefore when weather conditions are favorable for pole sweat —as they were in 1928—the amount of loss from this source is very large. A conservative estimate of the loss to the Connecticut growers this year is over a million dollars. With an expenditure of one-fifth of that amount, most of this could have been prevented.

Experiments which have been conducted in the experiment station sheds during the last four years and in the sheds of practical growers of both broadleaf and Havana Seed lead us to believe that fire curing should be practiced universally by stalk growers at least during seasons when the weather is conducive to sweat. In a later separate bulletin, full data on these experiments and more complete discussion of the practice will be published.

At this time, for the benefit of those who have not been accustomed to fire curing, the following recommendations are made, based on our experiments:

For every acre of tobacco a minimum of 50 bushels of charcoal should be on hand, *before* harvesting starts.

A larger number of small fires is better than a small number of large fires. The air drafts which are created by the fires are as important, if not more so than the actual heat produced. These drafts, therefore, should be distributed as much as possible over

the shed. A large number of fires prevents "dead air pockets'. The same result is obtained by the use of metal "spreaders" or covers over the fires. They also prevent scorching the tobacco directly over the fires.

The temperature should be kept between 85° and 95° F in the second tier. In very warm weather it may be necessary to raise this to 100° at times.

Firing to wilt, i. e., within a few days after filling the shed and while the leaves are still green is a good practice but is not always necessary for prevention of sweat. Pole sweat never attacks leaves when they are in the green stage. The late yellow and early brown stages are the danger stages.

If the tobacco is in those stages and wet weather sets in, with high humidity preventing evaporation of moisture from the leaves, it is time to start firing. Don't wait until the leaves begin to "puff" and the midribs "strut".

The condition of the tobacco should be the guide in firing. The minimum period of firing should be thirty-six hours. Frequently two or three times as long is necessary. When the leaves become dry in the green or yellow stage it is a sign you are firing too much.

The temperature should then either be reduced or the firing stopped entirely for a day and then started again if weather conditions demand. Intermittent firing is better than continuous firing except where pole sweat has already started and rapid drying is required.

All brown parts of the leaf should be dry. This is the best guide by which to know that you are firing enough.

During firing, the ridge and gable ventilators should be open but the side ventilators (boards) should be closed.

Some have the impression that fire cured tobacco is not so elastic as that which is cured naturally. We believe that this is due to curing too rapidly. Tobacco properly fire-cured is just as good as naturally cured tobacco in this respect.

EFFECT OF LIMING THE SOIL ON COMPOSITION OF TOBACCO

Tobacco from limed soils exhibits characters of combustion which are different from those of tobacco grown on soils which have not been limed. Some of these characters, particularly the whiteness of ash and closeness of burn are desirable; others, such as the "flaking" of ash and reduction in fire holding capacity, are objectionable. These differences in burn are probably correlated with changes which liming produces in the chemical composition of the leaf. From the standpoint of good growth of tobacco, heavy liming of the soil is not desirable but it is not beyond the range of possibility that the good effects on combustion may be produced by application of some material other than lime. Whether or not there is such a possibility can be intelligently determined

TABLE 38. ANALYSES OF TOBACCO FROM LIMED AND UNLIMED PLOTS. CROP OF 1926. WATER FREE BASIS

Plot No.	Grade	Lime	Percentage of minerals.						
			Total ash	P_2O_5	K_2O	CaO	MgO	Mn_2O_3	Al_2O_3
					FIELD VIII				
L	M	Lime	23.89	0.78	6.52	4.72	3.79	.01	.09
L1	M	Lime	23.05	0.73	6.38	4.82	3.58	.01	.08
L2	M	Lime	22.63	0.73	5.92	4.73	4.21	.01	.06
L3	M	Lime	22.90	0.74	6.06	4.79	3.89	.01	.08
L38	M	Lime	23.49	0.75	6.87	4.52	3.61	.01	.11
L39	M	Lime	21.83	1.05	6.37	4.13	3.12	.01	.08
C3-1	M	No lime	26.92	0.85	8.90	5.67	1.16	.10	.09
F6-1	M	No lime	28.15	0.87	8.36	6.55	1.19	.06	.21
N1-5	M	No lime	25.20	0.88	7.51	6.53	1.38	.06	.07
N1-6	M	No lime	25.22	0.93	7.62	6.13	1.29	.07	.07
					POQUONOC FIELD				
4A	All	Lime	24.57	0.77	6.79	4.98	3.11	.03	.17
15A	All	No lime	27.26	0.77	7.23	5.30	1.55	.21	.23
6A	All	No lime	28.19	0.85	7.80	5.84	1.18	.12	.31
					THIELAVIA PLOTS				
T1A	M	Lime	22.83	0.72	5.12	5.53	3.49	.01	.08
T1B	M	No lime	24.78	0.84	6.67	6.11	1.56	.29	.14
T1A	S	Lime	25.33	0.62	4.18	6.38	4.54	.02	.11
T1B	S	No lime	27.43	0.76	6.62	7.04	1.57	.28	.31
T2A	M	Lime	23.86	0.82	6.10	5.37	3.13	.01	.05
T2B	M	No lime	24.63	0.84	7.37	5.62	1.18	.04	.11
T2A	S	Lime	25.70	0.60	5.52	6.00	3.15	.02	.14
T2B	S	No lime	26.82	0.75	7.10	6.42	1.18	.04	.13
T3A	M	Lime	23.83	0.69	5.73	5.15	3.58	.01	.11
T3B	M	No lime	25.43	0.85	6.81	6.19	1.62	.06	.06
T3B	S	No lime	27.49	0.68	7.17	6.89	1.59	.09	.17

only after we have found out what changes lime has produced in the composition of the leaf.

Tobacco (of the crop of 1926) from limed and adjacent unlimed plots—which otherwise were identical in character of soil and previous treatment—was therefore analyzed by the Station Chemistry Department with respect to those elements which it was believed might be affected by liming. Three different series of plots were used in these Analyses as follows:

Limed plots on Field VIII. Beginning with 1922 these plots were limed heavily each year. With the last application in the spring of 1925 they had received during these four years five tons of hydrated lime per acre and the reaction of the soil was slightly above 7.0 pH.

Thielavia series. These consisted of three plots. One-half of each received an application of one ton of hydrated lime per acre each spring, beginning in 1924.

Poquonoc field. Plots on this field were limed at the same rate as the Thielavia series in the spring of 1925 and 1926.

The lime was not analyzed each year but it was commercial lime from western Massachusetts and unquestionably all of it had some magnesia in it. Some samples from that section have as high as 30% MgO.

Results of the analyses presented in Table 38 show that:

1. In every comparison, liming reduced the percentage of total ash, of calcium, phosphorus, manganese and potash. Aluminum was reduced in some cases but not in all.

2. In every case, liming approximately doubled the percentage of magnesium.

In experiments with tobacco in Ohio, Ames and Boltz (Ohio Sta. Bul. 285, 1915) also found that liming a soil reduced the percentage of calcium, potassium, manganese, phosphorus and sulfur but increased the magnesium.

Garner (U. S. D. A., Bur. Pl. Indus., Bul. 105) found that magnesium salts are injurious to fire holding capacity of tobacco (more so than the calcium salts). He also found that all magnesium salts produce a white ash.

Apparently the white ash and reduced fire holding capacity which we find on our limed plots are due to magnesium rather than to calcium.

The Effects of Magnesia, Sulphur and Chlorine on the Growth and Quality of Tobacco[1]

H. F. Murwin[2]

With the coming use of more concentrated fertilizers and syn-

[1]The plots were conducted on a cooperative arrangement between the United States Department of Agriculture and the Connecticut Agricultural Experiment Station.

[2]Agent, Office of Tobacco and Plant Nutrition, Bureau of Plant Industry, United States Department of Agriculture.

thetic nitrogen products in the tobacco growing industry it would be well to keep in mind the nutritional disturbances which may result. The trend today is toward the use of more concentrated mixtures which necessitates the use of more chemicals to replace some of the cottonseed meal or the like. We usually consider the value of a tobacco fertilizer in terms of nitrogen, phosphoric acid and potash. While these three elements are absolutely essential, the tobacco plant requires more than these three for normal growth. In this connection fertilizer tests have been conducted over a period of six years at the Tobacco Station in an effort to determine some specific effects of magnesia, sulphur and chlorine on the growth, quality and burn of Havana seed tobacco.

These fertilizer tests consisted of six treatments in duplicate on 1/40 acre plots. A basal ration which furnished only nitrogen, phosphoric acid and potash was applied on all plots. During the first three years of the experiment 40 pounds of nitrogen, 64 pounds of phosphoric acid and 80 pounds of potash were furnished annually in the basal ration. Starting with the 1925 season the quantities of nitrogen and potash applied annually were increased from year to year and in 1927 the basal mixture furnished about 200 pounds of nitrogen, 64 pounds of phosphoric acid and 200 pounds of potash per acre. The exact amounts and types of carriers used in this mixture are given in Table 39.

TABLE 39. COMPOSITION OF BASAL RATION. MAGNESIA, SULPHUR AND CHLORINE PLOTS—1927

Materials	Lbs. per acre	NH_3	P_2O_5	K_2O
Nitrate of potash	460.0	72.63	.....	199.6
Precipitated bone	166.5	.....	64.1	.....
Dried blood	200.0	31.56	.....	.....
Urea	119.0	65.45	.....	.....
Nitrate of soda	324.0	60.58	.....	.....
Total	1269.5	230.22	64.1	199.6

TABLE 40. PER ACRE AMOUNTS OF PURE CHEMICALS APPLIED IN MAGNESIA, SULPHUR AND CHLORINE TREATMENTS

Plot	Chemicals applied	Nutrients supplied
1 & 1+	Control	Control
2 & 2+	185 lbs. Magnesium Sulphate 88 lbs. Sodium Chloride	30 lbs. MgO; 60 lbs. SO_3 53 lbs. Cl; (50 lbs. Na_2O)
3 & 3+	185 lbs. Magnesium Sulphate	30 lbs. MgO; 60 lbs. SO_3
4 & 4+	150 lbs. Magnesium Chloride	30 lbs. MgO; 53 lbs. Cl
5 & 5+	185 lbs. Magnesium Sulphate 150 lbs. Magnesium Chloride	60 lbs. MgO; 60 lbs. SO_3 53 lbs. Cl
6 & 6+	107 lbs. Sodium Sulphate 88 lbs. Sodium Chloride	60 lbs. SO_3; 53 lbs. Cl; (96 lbs. Na_2O)

In addition to the basal ratio, magnesia, sulphur and chlorine were supplied annually as shown in Table 40. No magnesia has been applied on plots 1, 1+, 6 and 6+, no sulphur on plots 1, 1+, 4 and 4+, and no chlorine on plots 1, 1+ 3 and 3+ during the six years period. All other plots received applications of magnesia, sulphur and chlorine at the rates specified in the preceding table. Part of these fertilizers was uniformly drilled in the row a few days before transplanting the tobacco. The remaining portion was applied as top dressing at the time of the first hoeing. There were no great differences in field growth, but plots 1, 1+, 6 and 6+ were smaller and plots 4, 4+, 5 and 5+ were somewhat larger than the average.

The tobacco on all plots that received no magnesia in the fertilizer exhibited the light colored mottling characteristic of magnesium starvation during the seasons of 1922, '24, '25 and '27. Nearly one hundred percent of the leaves on some plots were mottled in 1927. This condition we term sand-drown. It might be well to briefly describe this malady. Magnesia deficiency results in a very characteristic mottling which ordinarily develops first on the lower leaves of the plant and usually begins at the tip and progresses inward toward the base of the leaf, more particularly between the veins and along the margins. When magnesia is not sufficiently available in the soil these symptoms appear and as magnesia is very mobile in the plant that which is already taken into the lower leaves is transferred to meet new needs in the growing region. Thus the malady progresses from the lower leaves upward as the season advances. The leaves do not become deformed as in the case of potash hunger because symptoms ordinarily develop on mature leaves.

It will be noted that no sand-drown was present in 1923 and '26. Sand-drown has not occurred in the Valley to any extent in the past except on sandy soil during seasons with heavy rainfall. This explains in part the irregularity of occurrence on these plots. Both surface and subsoil samples were analyzed for magnesia, sulphur and calcium in the Washington laboratories. These data show that the total magnesia content of this sandy soil was nearly equal to the content of calcium which is much higher than would be expected. There were no significant differences in treatments 1, 3 and 5 where 0, 30, and 60 pounds of magnesia, respectively, have been supplied annually for six years. Neither were there any differences in sulphur content but the total amount of sulphur was so low that accurate data could not be expected. With as high a total magnesia content as shown in these analyses evidently enough became available to the plant during the dry years to promote a normal growth. If the magnesia content of this soil had been depleted the absence of magnesia in the fertilizer would have greatly lowered both yield and quality. This has been shown by experiments in other sections. It has been reported by

the Tobacco Station that fifteen pounds of magnesia per acre has prevented the occurrence of sand-drown on the Station fertilizer plots. A number of cases of sand-drown were reported during the past season resulting from a combination of two things, an insufficient amount of magnesia applied, together with the heavy rainfall. This is just an indication of what may happen in the future when less nitrogen is supplied from organic sources which carry magnesia. The point is, if a shortage does occur, it must be corrected in one way or another if yield and quality are to be expected. But if the rate of application is excessive there is a tendency to decrease the quality of leaf. These tests have shown that 30 pounds of magnesia has been sufficient to prevent sand-drown in any year during the experiment but a number of instances can be cited where 15 pounds was not sufficient during the past season. No effects of sulphur or chlorine were discernible in the field except for slight differences in growth.

Plants were selected at harvest in 1925 from treatments 1, 3 and 5. The cured leaf and stalk were analyzed for magnesia in the laboratories at Washington. The results are given in Table 41.

Table 41. Magnesia Content of Cured Tobacco

Plot	Magnesia (MgO) supplied in Fert. per acre	Condition of leaf	% Magnesia (MgO) in water-free material	
			Leaf	Stalk
1	None	Sand-drown	.30	.25
3	30 lbs.	Normal	1.40	.37
5	60 lbs.	Normal	2.07	.45
1+A	None	Normal	.57	.27
1+B	None	Sand-drown	.27	.23

These data show that the amount of magnesia taken up by the plant is influenced by the amount applied to the soil. In other words, if sufficient magnesia is available in the soil sand-drown will not occur. They also show that the leaf is influenced much more than the stalk because of the greater metabolic activity in the leaf as compared with the stalk.

Table 42. Summary of the Yields Per Acre

Plot	1924	1925	1926	1927	Average	Plots	Ave. of 8 replications.
1	880	1456	1368	1266	1242	1 & 1+	1192
1+	780	1290	1392	1105	1142	....	....
2	1140	1465	1392	1364	1340	2 & 2+	1302
2+	1000	1425	1342	1288	1264	....	....
3	920	1490	1488	1362	1315	3 & 3+	1293
3+	900	1490	1379	1314	1271	....	....
4	1000	1537	1414	1347	1324	4 & 4+	1345
4+	1000	1582	1534	1348	1366	....	....
5	960	1443	1466	1448	1329	5 & 5+	1344
5+	1000	1540	1534	1368	1360	....	....
6	900	1321	1388	1250	1215	6 & 6+	1286
6+	1067	1477	1533	1352	1357	....	....

Yield and quality data were obtained from these plots the last four years of the experiment. A summary of these yields are presented in Table 42. We could not expect great differences in yield of cured leaf from such treatments unless either magnesia or sulphur was so depleted or unavailable to the plant as to be a limiting factor in growth processes. From the data presented this appears to be the case on plots which received no magnesia. The yields from the control plots which received no magnesia, sulphur or chlorine are considerably lower than the rest. Where only one of the elements was lacking the effect was not as marked. It is quite evident from a comparison of treatments 3 and 4, however, that somewhat larger yields were consistently obtained from the application of chlorine in absence of sulphur than from the application of sulphur in the absence of chlorine.

The cured leaf was assorted into the various commercial grades at the Tobacco Station shop. As it is rather difficult to keep a number of figures in mind, such as the percentages of assorted grades, when comparing two treatments, a single figure was devised to represent the quality of cured leaf from the entire plot. This single figure is termed the average price per pound and was computed from arbitrary values given to assorted grades. The average prices over a four year period are summarized in Table 43.

TABLE 43. A COMPARISON OF THE AVERAGE PRICE PER POUND

Plot	1924	1925	1926	1927	3 yr. ave. 1925-1927	Plots	Ave. of 8 replications.
1	.179	.277	.395	.316	.329	1 & 1+	.327
1+	.158	.262	.427	.285	.325	....	....
2	.148	.258	.329	.398	.328	2 & 2+	.340
2+	....	.298	.383	.378	.353	....	....
3	.155	.320	.408	.403	.377	3 & 3+	.377
3+	....	.340	.406	.388	.378	....	....
4	.169	.310	.368	.372	.350	4 & 4+	.369
4+	....	.342	.404	.420	.388	....	....
5	.151	.288	.401	.383	.357	5 & 5+	.350
5+	....	.282	.369	.380	.344	....	....
6	.175	.313	.408	.329	.350	6 & 6+	.356
6+	....	.357	.346	.385	.362	....	....

If quality is considered on this basis we obtained the lowest average price per pound when no magnesia, sulphur or chlorine were supplied in the fertilizer, and the highest average price when magnesia and sulphur were applied in the absence of chlorine. It will be noted that the quality of cured leaf improved from year to year with the increased annual application of nitrogen and potash but the relative effects of magnesia, sulphur and chlorine remained the same aside from effects on quality when sand-drown occurred.

Burn tests were conducted on samples of sweated tobacco from the four principle commercial grades in each treatment. An

electric resistance coil was used to initiate the burns in these tests. Two burns, one on either side of the mid rib and approximately in the center of the leaf were made on ten leaves from each grade.

TABLE 44. BURN TESTS ON THE 1925 SWEATED TOBACCO

Plot	Fire holding capacity of the leaf (Seconds) Light Wrappers	Medium Wrappers	Light Seconds	Darks	Plot Average	Average of duplicate plots
1	13.7	....	14.5	11.8	13.3	11.2
1+	10.5	9.9	9.6	5.9	9.0	
2	3.0	3.2	3.1	3.1	3.1	3.1
2+	3.3	2.6	3.9	2.7	3.1	
3	12.4	16.0	15.5	9.5	13.4	13.8
3+	17.5	13.9	....	11.2	14.2	
4	2.8	2.4	2.9	2.9	2.8	3.4
4+	5.9	2.8	3.0	....	3.9	
5	3.2	3.4	5.2	3.5	3.8	3.8
5+	3.1	2.9	6.1	2.6	3.7	
6	3.5	3.0	3.9	3.4	3.5	3.6
6+	3.2	4.2	3.7	....	3.7	

Each plot average represents eighty burn tests.

The decidedly harmful effect of chlorine is demonstrated in Table 44 where the average length of burns is recorded on the 1925 crop. While the fire-holding capacity, as determined by leaf tests, was poor throughout the experiment in 1925 the burn was three to four times as great in the no chlorine treatments. At the rates supplied in these tests sulphur and magnesia failed to show any harmful effects on the burn.

SUMMARY

The necessity for including magnesia in the fertilizer mixture is demonstrated by these data. This is of special importance at this time when the trend is toward more concentrated fertilizers.

If magnesia is deficient in the soil and is not supplied in the fertilizer both yield and quality of cured leaf may be greatly lowered.

The amount of magnesia taken up by the plant is influenced by the amount applied to the soil.

Both chlorine and magnesia increased the yields to some extent in these tests.

The treatments do not show any great differences in quality, although the poorest quality resulted from the control plots where no magnesia, sulphur or chlorine were supplied in the fertilizer.

Chlorine almost destroyed the fire-holding capacity of the cured leaf in these tests. Sulphur or magnesia failed to show any harmful effects on the burn at the rates supplied.

Bulletin 300 January, 1929

Connecticut Agricultural Experiment Station
New Haven, Connecticut

THE COMPOSITION OF SOME COMMERCIAL INSECTICIDES, FUNGICIDES, BACTERICIDES, RODENTICIDES AND WEED KILLERS

A COMPILATION

H. J. Fisher and E. M. Bailey

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

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Press of The Wilson H. Lee Co., New Haven, Conn.

The Composition of Some Commercial Insecticides, Fungicides, Bactericides, Rodenticides and Weed Killers. A Compilation.

H. J. Fisher and E. M. Bailey.

Frequent requests for information as to the composition of commercial insecticides, fungicides and similar materials suggested the desirability of assembling the data on this subject to be found not only in various bulletins of this station but in those of institutions in other States where similar work is carried on. Designed at first for our own convenience, it was later felt that the information would be useful also to others interested. No pretense is made that the compilation is complete, but it is, at least, fairly comprehensive. For the most part the data were obtained from regular or special bulletins submitted by experiment stations or other state departments in response to our request for information on this subject. If any important sources of information are omitted it is because our requests were not referred to, or did not reach, the proper authorities.

In the case of insecticides which are definite compounds, sold under their own or well recognized names, such as arsenate of lead, Paris green, sulphur, etc., the publication of very old analyses did not seem to be warranted, and only those analyses reported from 1918 to the present are included in this index. In the case of products sold under proprietary names which do not make their composition readily evident, all analyses found are included however long ago they may have been published.

Only one analysis is given for each product except in those cases where different analyses have shown widely different composition. In such cases several analyses are included. An attempt was made to insert the latest analysis found in each case. When the latest publication found containing analyses of a certain insecticide or other product has given several analyses of that product, the figures in the index are usually averages.

It should be noted that the percentages given under "guaranteed" in the index represent maximum amounts in the case of water, inert matter and water-soluble arsenic, while the guaranties for other constituents are usually stated by the manufacturers as "not less than" the amount specified.

The index is arranged in alphabetical order by names of the products. Names beginning with arabic numerals are indexed as they would be if the numeral were spelled, - i.e., "20" is listed under "T". Certain common classes of insecticides are grouped together in tables alphabetically by the names of the manufacturers, but they are also cross-indexed by the names of the brands. An exception to this rule is made in the case of arsenate of calcium, arsenate of lead, Bordeaux mixture, lime-sulphur, London purple, Paris green and sulphur, which will not be found listed separately by the brand names, but only under the tables for these respective classes of insecticides.

Reference is made after each analysis to the source from which it was obtained. Some of the analyses are those made at this Station and not previously published. After such analyses the sample number and "Conn. Agr. Expt. Sta." is given in place of a publication reference.

No responsibility is assumed for the correctness of any analyses other than those made by this Station.

The following publications were abstracted:

California Department of Agriculture, Special Publications 34 (1923); 51 (1925); 58 (1925); 66 (1926); 75 (1927).

Canada Laboratory of the Inland Revenue Department, Bulletins 158 (1908); 205 (1910); 284 (1914); 303 (1915); Department of Agriculture, Division of Chemistry, Report of the Dominion Chemist (1928).

Colorado Sixteenth Annual Report of State Entomologist, Circular 47 (1925).

Connecticut Agricultural Experiment Station, Bulletins 157 (1907); 242 (1922); 258 (1924); 272 (1925).

Maine Agricultural Experiment Station, Bulletin 154 (1908); Official Inspections 110 (1923); 114 (1924); 118 (1925); 122 (1926); 126 (1927).

Michigan Agricultural College Experiment Station, Special Bulletin 74 (1915).

New Jersey Agricultural Experiment Stations, Bulletins 214 (1908); 222 (1909); 262 (1913); 273 (1914); 286 (1915); 301 (1916); 407 (1924); 424 (1925); 441 (1926); 459 (1927).

New York Agricultural Experiment Station, Bulletin 348 (1912); 384 (1914).

North Dakota Office of the State Food Commissioner and Chemist, Bulletin 17 (1927).

Oregon Agricultural College Experiment Station, Circular 64 (1925); 84 (1927)

Pennsylvania Department of Agriculture, Bureau of Chemistry, Bulletins 166 (1910); 192 (1909).

University of California College of Agriculture, Agricultural Experiment Station Bulletin 151 (1903).

U. S. Department of Agriculture, Bureau of Chemistry, Bulletin 68 (1902).

U. S. Department of Agriculture, Department Bulletin 1439 (1926).

U. S. Department of Agriculture Farmers' Bulletin 146 (1902).

A

Ace-Hy.

(GENERAL CHEMICAL CO., NEW YORK, N. Y.)

Guaranteed: Inert matter (water), not more than 40 per cent.

Found: The preparation is an emulsion in which a cyanide, equivalent to 2.29 grams CN per 100 cc was the chief active ingredient detected. The ash, 3.58 per cent, consisted chiefly of iron and copper oxides. Water and volatile matter (at 100° C), made up 77.3 per cent of the material.—*Conn. Agr. Expt. Sta. Bull.* 242, 161 (1922).

Acid Carbolic.

See "Phenol."

Acid Hydrocyanic.

See "Hydrocyanic Acid."

Acme Garden Guard.

(ACME WHITE LEAD & COLOR WORKS, DETROIT, MICH.)

	Guaranteed.	Found.
Copper	....	1.77
Total arsenic, metal	1.70	1.98
Water-soluble arsenic, metal	0.25	0.50
Copper aceto-arsenite	4.50	....
"Copper of bordo"	0.50	....
Sulphur	4.00	3.90

Cal. Dept. Agr., Spec. Pub. 75, 44 (1927).

Acme Sheep and Cattle Dip.

See "Phenol-Soap Solutions."

Acme 2-way Spray.

See "Bordeaux Mixture—Lead Arsenate."

Acto.

See "Oils, Mineral."

Adheso Green Label.

(ANSBACHER INSECTICIDE CO., INC., NEW YORK, N. Y.)

	Guaranteed.	Found.
Moisture	....	58.39
Total arsenic, metal	5.50	5.56
Water-soluble arsenic, metal	0.50	0.05
Copper	4.00	4.15

N. J. Agr. Expt. Sta., Bull. 459, 10 (1927).

Adheso 7 O-Blue Dust.

(ANSBACHER INSECTICIDE CO., INC., NEW YORK, N. Y.)

	Guaranteed.	Found.
Copper	7.00	7.25

N. J. Agr. Expt. Sta., Bull. 459, 10 (1927).

Adheso-Yellow Label.

See "Concentrated Adheso."

A D S Rat and Roach Paste.

See "Phosphorus Preparations."

Aero Brand Hydrocyanic Acid.

See "Hydrocyanic Acid."

Aero Rodent Exterminator.

See "Calcium Cyanide."

Agricultural Sulphur Compound.

(TOYAH VALLEY SULPHUR CO., NEW ORLEANS, LA.)

Found: Sulphur 21.50 per cent.—*N. J. Agr. Expt. Sta., Bull.* 441, 7 (1926).

Agri-Pax.

(PAX MFG. CO., NEW YORK, N. Y.)

Declared: "A contact spray insecticide based on the extract of pyrethrum. Inert material water 77 per cent."

Found: Chloroform extract 20.54 per cent; fatty acids 18.83 per cent; moisture 74.2 per cent. Calculated composition: soap 21.37 per cent; pyrethrum extract 1.71 per cent; moisture 74.2 per cent; undetermined 2.72 per cent.—*Conn. Agr. Expt. Sta.*, Sample 9305.

Albatross Puritol.

(GENERAL BASIC PRODUCTS CO.)

	Guaranteed.	Found.
Active Ingredients:	3.00	....
Oils	....	1.20
Phenols	....	0.40
Inert Ingredients:		
Whiting	91.50	90.50
Glue	5.00	5.40
Volatile at 100° C.	0.50	1.50

Cal. Dept. Agr., Spec. Pub. 75, 66 (1927).

Alcopol Oil.

Aleph Oil

See "Oils, Mineral."

Alhambra Nico-Soap.

See "Nicotine Soaps."

Alhambra Spray.

See "Oil Emulsions, Mineral."

Allan's Lightning Roach Paste.

See "Phosphorus Preparations."

Allen's Kilto, Paste.

(W. A. ALLEN, PITTSTOWN, N. J)

	Guaranteed.	Found.
Moisture	....	55.17
Total arsenic, metal	6.52	4.73
Water-soluble arsenic, metal	0.50	0.08
Copper	4.00	5.02

N. J. Agr. Expt. Sta., Bull. 441, 10 (1926).

All in One.

See "Niagara All in One" and "No. 6 All in One Dust."

Altair Oil.

See "Oils, Mineral."

American Jazz Spray.

See "Oil Emulsions, Mineral."

Ammonia Spray.

(BEAR AMMONIA CO., RIVERSIDE, CAL.)

Found: Moisture 18.33 per cent; sodium carbonate 63.50 per cent; sodium chloride 3.20 per cent; soap 12.85 per cent; calcium carbonate 2.09 per cent.—*Cal. Dept. Agr., Spec. Pub.* 51, 58 (1925).

Anchor Brand Hellebore.

See "Hellebore."

An-Fo Disinfectant.

(AN-FO MFG. CO., OAKLAND, CAL.)

See "Phenol-Soap Solutions."

An-Fo Louse Powder.

(ANIMAL FOOD CO., OAKLAND, CAL.)

Not chemically analyzed.—*Cal. Dept. Agr., Spec. Pub.* 58, 48 (1925).

An-Fo Nicotine Spray.

(AN-FO MFG. CO., OAKLAND, CAL.)

See "Nicotine Soaps."

An-Fo Round Worm Capsules.

(AN-FO MFG. CO., OAKLAND, CAL.)

	Guaranteed.	Found.
Nicotine	15.00	16.36

Cal. Dept. Agr., Spec. Pub. 66, 26 (1926).

An-Fo Sheep Dip.

See "Phenol-Soap Solutions."

Ansbor Green.

(ANSBACHER INSECTICIDE CO., INC., NEW YORK, N. Y.)

	Guaranteed.	Found.
Total arsenic, metal	12.50	16.14
Water-soluble arsenic, metal	3.00	0.27
Copper	....	17.62

N. J Agr. Expt. Sta., Bull. 459, 10 (1927).

Ant Destroyer.

(PETER HENDERSON, NEW YORK, N. Y.)

Found: Borax 54.12 per cent; cane sugar 44.80 per cent.— *U. S. D. A., Bur. Chem., Bull.* 68. 43 (1902).

Ant Eater.

(AN-FO MFG. CO., OAKLAND, CAL.)

	Guaranteed.	Found.
Total arsenic	0.17	0.16

Cal. Dept. Agr., Spec. Pub. 75, 24 (1927).

Ant Foil Ant Poison.

(AN-FO MFG. CO., OAKLAND, CAL.)

	Guaranteed.	Found.
Arsenious oxide	....	0.16
Arsenic, metal	0.10	0.12

Cal. Dept. Agr., Spec. Pub. 66, 19 (1926).

Anthracine Oil Emulsion.

(THE SHERWIN-WILLIAMS CO., CLEVELAND, OHIO.)

Guaranteed: Anthracene oil 75 per cent; fish oil soap 3 per cent; water 22 per cent.

Found: Total oil 72.63 per cent; water 25.08 per cent; soap and undetermined 2.29 per cent.—*Conn. Agr. Expt. Sta., Bull.* 272, 148 (1925).

Anti-Ant Argentine Ant Poison.

(BRUNSWIG DRUG CO., LOS ANGELES, CAL.)

Guaranteed: Arsenic metal 0.20 per cent.

Found: Arsenious oxide 0.76 per cent; arsenic metal 0.057 per cent; dextrose 45.36 per cent; maltose 5.87 per cent; dextrin 0.54 per cent; moisture 46.61 per cent.—*Cal. Dept. Agr., Spec. Pub.* 58, 16 (1925).

Antiseptic Sheep Dip.

See "Phenol Soap Solutions."

Ant Poison.

(ALDERMAN CO., INC., PASADENA, CAL.)

Found: Arsenious oxide 0.19 per cent; arsenic metal 0.14 per cent.—*Cal. Dept. Agr., Spec. Pub.* 58, 16 (1925).

Antrol Argentine Ant Syrup.

(ANTROL LABORATORIES, INC., LOS ANGELES, CAL.)

	Guaranteed.	Found.
Arsenic, metal	0.10	0.12

Cal. Dept. Agr., Spec. Pub. 75, 24 (1927).

Ant Syrup.

(SMALLS SEED CO., RIVERSIDE, CAL.)

	Guaranteed.	Found.
Arsenic, metal	0.10	0.17

Cal. Dept. Agr., Spec. Pub. 75, 24 (1927).

A-1 Dust Mixture.

See "Nicotine Dusts."

Aphid Spray.

(RADIUM SPECIALTIES MFG. CO., SAN FRANCISCO, CAL.)

Found: Light rosin oil 95.4 per cent; water 4.6 per cent.—*Cal. Dept. Agr., Spec. Pub.* 34, 58 (1923).

Aphine.

(APHINE MFG. CO., MADISON, N. J.)

Guaranteed: Nicotine 0.90 per cent.

Found: Nicotine 1.07 per cent. Cedar and pine oils and potassium hydroxide present.—*N. J. Agr. Expt. Sta., Bull.* 407, 10 (1924)—*N. Y. Agr. Expt. Sta., Bull.* 384, 301 (1914).

Aphis Getter.

(WALNUT CREEK SPRAY CO., WALNUT CREEK, CAL.)

	Guaranteed.	Found.
Water	92.00	69.20

Cal. Dept. Agr., Spec. Pub. 66, 36 (1926).

Aphistrogen.

(CHEMICAL PRODUCTS DIVISION, ROSE MFG. CO., PHILADELPHIA. PA.)

Guaranteed: $C_{35}H_{46}O_{10}$ about ¾-1 per cent; "trioxymethaline" about ¾-1 per cent; available nitrogen about 0.4 per cent; "inert remedial substances" about 94 per cent. "Aphistrogen is the active glucoside content of a vegetable substance. Aphistrogen being highly concentrated goes 60 times farther than the amount you pay for. Aphistrogen is prepared after the famous Rosenbluth formula, combined with a fertilizer as used with unprecedented success at the nationally known Rose Gardens at Wallingford, Pa."

Found: The preparation is a soap emulsion. Total nitrogen 0.14 per cent; water 80.9 per cent; formaldehyde recovered by steam distillation 0.05 per cent.—*Conn. Agr. Expt. Sta.*, Sample 9306.

Apricot Oil.

See "Oil Emulsions, Mineral."

Arcol.

See "Phenol Soap Solutions."

Arctic Whale Oil Soap.

See "Soaps."

Argentine Ant Poison.

(COFFIN-REDINGTON CO., SAN FRANCISCO, CAL.)

Guaranteed: Arsenious oxide 0.20 per cent; arsenic metal 0.15 per cent.

Found: Arsenious oxide 0.26 per cent; arsenic metal 0.20 per cent; invert sugar 10.79 per cent; cane sugar 17.47 per cent; dextrin, etc., 11.53 per cent. water 59.94 per cent.—*Cal. Dept. Agr., Spec. Pub.* 58, 16 (1925).

Argentine Ant Poison

(FEDERAL DRUG CO., OAKLAND, CAL.)

	Guaranteed.	Found.
Arsenious oxide	....	0.11
Arsenic, metal	0.25	0.08

Cal. Dept. Agr., Spec. Pub. 66, 19 (1926).

Argentine Ant Poison.

(C. W. HILL CHEMICAL CO., LOS ANGELES, CAL.)

	Guaranteed.	Found.
Total arsenic, metal	0.10	0.097
Water-soluble arsenic, metal	0.10	0.097

Cal. Dept. Agr., Spec. Pub. 34, 18 (1923).

Argentine Ant Poison.

(LOS ANGELES CHEMICAL CO., LOS ANGELES, CAL.)

Guaranteed: Arsenic metal 0.10 per cent.

Found: Arsenious oxide 0.13 per cent; arsenic metal 0.099 per cent; invert sugar 8.64 per cent; cane sugar 39.66 per cent; dextrin, etc. 0.21 per cent; water 51.64 per cent.—*Cal. Dept. Agr., Spec. Pub.* 58, 17 (1925).

Argentine Ant Poison.

(PHILIP & PHILIP, OAKLAND, CAL.)

	Guaranteed.	Found.
Arsenious oxide	....	0.16
Arsenic, metal	0.11	0.12

Cal. Dept. Agr., Spec. Pub. 58, 17 (1925).

Argentine Ant Poision.

(ROSE WATERMAN DRUG CO.)

	Guaranteed.	Found.
Arsenious oxide	....	0.20
Arsenic, metal	0.20	0.15

Cal. Dept. Agr., Spec. Pub. 66, 19 (1926).

Argentine Ant Poison.

(TOWNE ALLISON DRUG CO., SAN BERNARDINO, CAL.)

Found: Total arsenious oxide 0.60 per cent; water-soluble arsenious oxide 0.60 per cent.—*Cal. Dept. Agr., Spec. Pub.* 34, 18 (1923).

Argentine Ant Poison.

(WEBB & SEWARD, PASADENA, CAL.)

	Guaranteed.	Found.
Arsenious oxide	....	0.09
Arsenic, metal	0.20	0.07

Cal. Dept. Agr., Spec. Pub. 58, 17 (1925)

Argo Ant Poison.

(BOWMAN DRUG. CO.)

	Guaranteed.	Found.
Arsenic, metal	0.11	0.15

Cal. Dept. Agr., Spec. Pub. 75, 24 (1927).

A. R. M. Liquid Lice Killer.

(ARTHUR R. MAAS CHEMICAL CO.)

Guaranteed: Water 5.00 per cent.

Found: Phenols 14.50 per cent; coal-tar oils 84.80 per cent; water 0.40 per cent.—*Cal. Dept. Agr., Spec. Pub.* 75, 56 (1927).

Arsenate of Calcium. Arsenate of Lead.

See Tables I and II.

Arsenate of Barium.

See "White Arsenoid."

Arsenite of Lead.

See "Pink Arsenoid."

Arsenite of Zinc.

See Table III.

Arsenoid, Pink.

See "Pink Arsenoid."

Arsenoid, Soluble.

See "Watson."

Arsenoid White.

See "White Arsenoid."

Arsite.

(MORRIS HERRMANN & CO., NEW YORK, N. Y.)

	Guaranteed.	Found.
Total arsenic, metal	28.8	31.05
Water-soluble arsenic, metal	28.8	31.05

Mich. Agr. College, Expt. Sta., Spec., Bull. 74, 10 (1915).

At-Ko Brand Sheep Dip.

See "Phenol Soap Solutions."

Atlas "A" Weed Killer.

(CHIPMAN CHEMICAL CO., NEW YORK, N. Y.)

Guaranteed: Sodium arsenite 45 per cent.

Found: Total arsenic metal 23.67 per cent; sodium arsenite (Na_2HAsO_3) 53.64 per cent.—*Conn. Agr. Expt. Sta., Bull.* 272, 149 (1925).

Atlas Weed Killer.

(CHIPMAN CHEMICAL ENGINEERING CO., INC. NEW YORK, N. Y.)

Found: Sodium chlorate 19.22 per cent; sodium chloride 18.73 per cent; water 57.59 per cent.—*Cal. Dept. Agr., Spec. Pub.* 75, 65 (1927).

Avenarius Carbolineum.

(CARBOLINEUM WOOD PRESERVING CO.)

	Guaranteed.	Found.
Water	1.50	1.43
Carbon	0.50	0.97

Cal. Dept. Agr., Spec. Pub. 75, 65 (1927).

Avon Brown Neutral.

See "Oils, Mineral."

Axfixo.

See "Nicotine Dusts."

B.

B. A. Cartridges.

See "Key Brand B. A. Cartridges."

Bacili-Kil.

See "B-K Bacili-Kil."

Barium Arsenite.

See "White Arsenoid."

TABLE I. ARSENATE OF CALCIUM.

Manufacturer or Distributor and Brand	Arsenic Oxide, As_2O_5				Calcium Arsenate, $Ca_3(AsO_4)_2$	Publication
	Total.		Water-soluble			
	Guaranteed	Found	Guaranteed	Found		
Ansbacher Insecticide Co., Inc., New York, N. Y.	39.87	41.79	1.53	0.31	72.39	N. J. Agr. Expt. Sta., Bull. 459, 6 (1927).
Apothecaries Hall Co., Waterbury, Conn.	39.87	38.89	1.15	0.67	67.34	Maine Agr. Expt. Sta., Official Inspection 126, 84 (1927).
Joseph Beech, Boston, Mass.	39.87	41.58	1.15	0.15	72.02	Maine Agr. Expt. Sta., Official Inspections 114, 86 (1924).
Bowker Chemical Co., New York, N. Y. Bowker's Calcide	39.87	41.17	1.15	0.24	71.30	N. J. Agr. Expt. Sta., Bull. 459, 6 (1927).
Chipman Chemical Engineering Co., Inc., New York, N. Y.	39.87	41.92	0.75	0.57	72.60	N. J. Agr. Expt. Sta., Bull. 407, 8 (1924).
Deloro Chemical Co., Deloro, Ont., Canada	....	44.06	....	0.08	....	Canada Dept. Agr., Div. Chem., Rept. Dominion Chemist (1928).
Dow Chemical Co., Midland, Mich. Dow	40.00	39.89	0.75	0.54	69.01	Cal. Dept. Agr., Spec. Pub. 75, 21 (1927).
General Chemical Co., New York, N. Y. Orchard	41.00	41.86	0.75	0.52	72.42	Cal. Dept. Agr., Spec. Pub. 75, 21 (1927).
The Glidden Co., Reading, Pa.	45.84	41.51	1.53	2.41	71.89	N. J. Agr. Expt. Sta., Bull. 407, 8 (1924).
Interstate Chemical Co., Jersey City, N. J. Key	39.87	42.03	1.15	0.18	72.79	N. J. Agr. Expt. Sta., Bull. 459, 6 (1927).
Leggett & Bro., Inc., New York, N. Y. Anchor	39.87	42.76	1.15	0.61	74.05	N. J. Agr. Expt. Sta., Bull. 424, 9 (1925).
John Lucas & Co., Inc., Philadelphia, Pa.	39.87	40.97	1.15	0.43	70.95	N. J. Agr. Expt. Sta., Bull. 424, 9 (1925).

Lucas-Kil-Tone Co., Vineland, N. J., Green Cross	39.87	40.61	0.77	0.21	70.32	N. J. Agr. Expt. Sta., Bull. 459, 6 (1927).
Manufacturer unknown	20.14	....	....	0.82	....	Canada Dept. Agr., Div. Chem., Rept. Dominion Chemist (1928).
Mechling Bros. Chemical Co., Camden, N. J	39.87	39.10	1.00	0.12	67.72	N. J. Agr. Expt. Sta., Bull. 459, 6 (1927).
Michel & Pelton Co., San Francisco, Cal.	40.00	43.47	1.15	0.69	75.20	Cal. Dept. Agr., Spec. Pub. 75, 21 (1927).
National Chemical Co. of California, El Centro, Cal. Flag	40.00	41.53	0.77	0.43	71.85	Cal. Dept. Agr., Spec. Pub. 75, 21 (1927).
Niagara Sprayer Co., Middleport, N. Y. Niagara	40.00	41.04	0.77	0.49	70.99	Cal. Dept. Agr., Spec. Pub. 75, 21 (1927).
Nitrate Agencies Co., New York, N. Y. Naco	40.02	42.76	0.75	0.74	74.05	N. J. Agr. Expt. Sta., Bull. 424, 9 (1925).
Pittsburgh Plate Glass Co., Newark, N. J. Corona Calsenate	40.00	40.71	1.15	0.46	70.42	Cal. Dept. Agr., Spec. Pub. 75, 21 (1927).
Riches, Piver & Co., New York, N. Y. Ceres	39.87	44.70	1.15	0.72	77.42	N. J. Agr. Expt. Sta., Bull. 424, 9 (1925).
Sherwin-Williams Co., Cleveland, Ohio	40.00	41.49	0.77	0.44	71.78	Cal. Dept. Agr., Spec. Pub. 75, 22 (1927).
Vreeland Chemical Mfg. Co., Little Falls, N. J. Electro	39.87	42.33	1.15	0.06	73.30	N. J. Agr. Expt. Sta., Bull. 441, 6 (1926).
Western Wholesale Drug Co., Los Angeles, Cal. Devoe	40.00	41.01	0.77	1.66	70.95	Cal. Dept. Agr., Spec. Pub. 75, 22 (1927).

TABLE II. ARSENATE OF LEAD

Manufacturer or Distributor and Brand	Water		Arsenic Oxide, As_2O_5				Lead Oxide, PbO		Publication
			Total		Water-Soluble				
	Guaranteed	Found	Guaranteed	Found	Guaranteed	Found	Guaranteed	Found	
	%	%	%	%	%	%	%	%	
Acme White Lead & Color Works, Detroit, Mich. Acme	....	....	30.00	33.12	1.00	0.14	....	63.65	Conn. Agr. Expt. Sta., Bull. 242, 151 (1922).
Ansbacher Insecticide Co., New York, N. Y.	....	....	30.00	32.22	1.00	0.59	....	65.16	N. J. Agr. Expt. Sta., Bull. 459, 5 (1927).
The James Blanchard Co., New York, N. Y.	....	....	....	30.80	....	0.23	....	66.90	Ore. Agr. Expt. Sta., Cir. 64, 8 (1925).
Bowker Insecticide Co., Boston, Mass. Bowker's	50.00	49.45	15.00	15.60	0.60	0.09	....	32.37	Conn. Agr. Expt. Sta., Bull. 272, 145 (1925).
Bowker Insecticide Co., Boston, Mass. Bowker's	....	....	30.00	30.59	0.77	0.38	....	66.31	Conn. Agr. Expt. Sta., Bull. 242, 150 (1922).
California Rex Spray Co., Benicia, Cal. NuRexform	....	....	30.00	31.51	0.77	0.45	....	64.50	Cal. Dept. Agr., Spec. Pub. 75, 14 (1927).
California Rex Spray Co., Benicia, Cal. Rex Basic	....	....	22.00	22.23	0.77	0.21	....	74.93	Cal. Dept. Agr., Spec. Pub. 75, 17 (1927).
California Rex Spray Co., Benicia, Cal. Rex Neutral Dry	....	....	24.00	32.77	0.77	0.46	....	64.70	Cal. Dept. Agr., Spec. Pub. 66, 16 (1926).
California Spray Chemical Co., Watsonville, Cal. Ortho Spray Basic	....	....	22.00	22.62	....	0.12	....	75.19	Cal. Dept. Agr., Spec. Pub. 75, 17 (1927).
California Spray Chemical Co. Watsonville, Cal. Ortho Spray Standard	....	....	30.00	31.97	....	0.23	....	65.25	Cal. Dept. Agr., Spec. Pub. 75, 14 (1927).
Chipman Chemical Engineering Co., New York, N. Y. Chipman	....	....	30.00	31.00	1.07	0.21	....	63.95	Conn. Agr. Expt. Sta., Bull. 272, 145 (1925).
Corona Chemical Co., Milwaukee, Wis. Corona Dry	....	....	30.00	32.20	0.77	0.18	....	64.25	Conn. Agr. Expt. Sta., Bull. 242, 150 (1922).

Deloro Chemical Co., Deloro, Ont., Canada	....	0.28	....	31.71	....	0.08	....	64.80	Canada Dept. Agr., Div. Chem., Rept. Dominion Chemist (1928).
Detroit White Lead Works, Detroit, Mich. Rogers	....	....	30.00	31.51	1.00	0.18	....	63.23	Conn. Agr. Expt. Sta., Bul. 242, 150 (1922).
Devoe & Raynolds Co., Inc., New York, N. Y. Devoe Standard	....	....	31.00	32.66	1.00	0.97	63.00	63.65	Conn. Agr. Expt. Sta., Bull. 242, 150 (1922).
John Dorland, Cobalt, Ont., Canada[1]	....	....	....	....	....	....	....	....	Canada Dept. Agr., Div. Chem., Rept. Dominion Chemist (1928).
The Dow Chemical Co., Midland, Mich. Dow	....	....	30.00	31.59	0.99	0.72	....	64.03	Cal. Dept. Agr., Spec. Pub. 75, 14 (1927).
General Chemical Co., New York, N. Y. Orchard	....	....	30.00	31.74	1.50	0.18	....	65.07	Conn. Agr. Expt. Sta., Bull. 242, 150 (1922).
General Chemical Co., New York, N. Y. Orchard Basic	....	....	22.00	22.35	0.38	0.18	....	72.73	Cal. Dept. Agr., Spec. Pub. 75, 17 (1927).
General Chemical Co., New York, N. Y. Orchard Paste	....	51.00	15.00	15.48	0.38	0.17	....	31.16	Cal. Dept. Agr., Spec. Pub. 75, 14 (1927).
General Chemical Co., New York, N. Y. Orchard Tri Plumbic	....	....	25.00	26.80	0.38	0.34	....	69.90	Cal. Dept. Agr., Spec. Pub. 75, 20 (1927).
General Chemical Co., New York, N. Y. Orchard Tri Plumbic, Paste	52.00	52.93	12.50	12.99	0.38	0.31	....	33.51	Cal. Dept. Agr., Spec. Pub. 66, 16 (1926).
The Glidden Co., Cleveland, Ohio. Glidden	....	....	31.00	31.97	0.77	0.44	....	63.46	Conn. Agr. Expt. Sta., Bull. 242, 150 (1922).
The Grasselli Chemical Co., New York, N. Y. Grasselli	....	....	31.00	31.00	1.15	0.16	....	62.65	Conn. Agr. Expt. Sta., Bull. 272, 145 (1925)
The Grasselli Chemical Co., New York, N. Y. Basic Powder	....	....	23.00	23.57	0.75	0.17	....	74.10	Cal. Dept. Agr., Spec. Pub. 66, 16 (1926).
The Grasselli Chemical Co., Cleveland, Ohio. Grasselli Paste	50.00	43.73	15.00	17.80	0.50	0.29	....	36.47	Conn. Agr. Expt. Sta., Bull. 242, 150 (1922).
C. W. Hill Chemical Co., Los Angeles, Cal. Mission	....	0.18	....	31.28	....	0.33	....	64.84	Cal. Dept. Agr., Spec. Pub. 34, 15 (1922).
Interstate Chemical Co., Jersey City, N. J. Key-Dry	....	....	30.00	30.88	0.75	0.23	....	63.18	Conn. Agr. Expt. Sta., Bull. 242, 150 (1922) and Bull. 272, 145 (1925).
Interstate Chemical Co., Jersey City, N. J. Key Brand Paste	....	....	15.50	17.04	....	0.60	....	35.16	N. J. Agr. Expt. Sta., Bull. 424, 8 (1925).
The Kil-Tone Co., Vineland, N. J.	....	....	30.00	30.24	1.15	0.18	....	63.55	Conn. Agr. Expt. Sta., Bull. 272, 145 (1925).

[1]Found to be ground gypsum.

TABLE II. ARSENATE OF LEAD—*Concluded.*

Manufacturer or Distributor and Brand	Water		Arsenic Oxide, As_2O_5				Lead Oxide, PbO		Publication
			Total		Water-Soluble				
	Guaranteed	Found	Guaranteed	Found	Guaranteed	Found	Guaranteed	Found	
	%	%	%	%	%	%	%	%	
Latimer-Goodwin Chemical Co., Latimer	....	....	28.38	30.94	0.77	0.32	....	64.07	Cal. Dept. Agr., Spec. Pub. 75, 15 (1927).
Leggett & Bro., New York, N. Y.	50.00	44.23	14.00	18.03	0.75	0.11	30.00	36.43	Conn. Agr. Expt. Sta., Bull. 242, 150 (1922).
Leggett & Bro., New York, N. Y.	....	....	30.00	32.66	1.00	0.28	61.00	64.50	Conn. Agr. Expt. Sta., Bull. 242, 150 (1922).
John Lucas & Co., Inc., Philadelphia, Pa.	....	....	30.00	32.31	1.15	0.40	....	64.40	Cal. Dept. Agr., Spec. Pub. 75, 15 (1927).
Lucas Kil-Tone Co., Vineland, N. J. Green Cross	....	....	30.00	30.30	1.01	0.58	....	66.25	Cal. Dept. Agr., Spec. Pub. 75, 20 (1927).
R. G. Maxtone-Graham, Berkeley, Cal.	....	0.40	....	30.38	....	0.38	....	63.50	Cal. Dept. Agr., Spec. Pub. 34, 15 (1922).
Mechling Bros. Chemical Co., Camden, N. J. Paste and Water	....	68.28	10.00	9.89	0.75	0.07	....	20.94	N. J. Agr. Expt. Sta., Bull. 459, 6 (1927).
Mechling Bros. Chemical Co., Camden, N. J. Powder	....	....	31.00	31.80	0.75	0.21	....	65.20	N. J. Agr. Expt. Sta., Bull. 459, 5 (1927).
Merrimac Chemical Co., Boston, Mass. Swift's	50.00	50.43	12.50	14.61	0.75	0.26	31.50	33.48	Conn. Agr. Expt. Sta., Bull. 242, 150 (1922).
Montgomery Ward & Co., Portland, Ore.	....	....	30.00	31.50	1.00	0.20	63.00	65.10	Ore. Agr. Expt. Sta., Cir. 84, 8 (1927).
National Chemical Co., Pittsburg, Pa. Flag	....	....	30.00	31.39	0.77	0.27	....	64.26	Cal. Dept. Agr., Spec. Pub. 75, 15 (1927).
National Chemical Co., Pittsburg, Pa. Flag Basic	....	....	22.00	22.16	0.77	0.11	....	74.36	Cal. Dept. Agr., Spec. Pub. 75, 18 (1927).

Niagara Sprayer Co., Middleport, N. Y. Niagara	....	....	30.00	31.54	1.15	0.18	....	64.35	Conn. Agr. Expt. Sta., Bull. 272, 145 (1925).
Niagara Sprayer Co., Middleport, N. Y. Niagara Basic	....	....	22.00	22.52	0.77	0.11	....	75.28	Cal. Dept. Agr., Spec. Pub. 75, 18 (1927).
Niagara Sprayer Co., Middleport, N. Y. No. 1 Niagara Entodust	....	....	30.00	31.17	0.77	0.29	....	66.20	Cal. Dept. Agr., Spec. Pub. 75, 15 (1927).
Nitrate Agencies Co., New York, N. Y. Naco	....	....	30.00	30.59	1.53	1.10	62.00	65.50	Conn. Agr. Expt. Sta., Bull. 242, 150 (1922).
The Oderberg Chemical Works, Ltd., Oderberg, Czechoslovakia	....	....	....	27.06	....	2.16	....	59.96	Conn. Agr. Expt. Sta., Sample 420.
Pittsburgh Plate Glass Co., Newark N. J. Corona Dry	....	....	....	31.86	....	0.14	....	65.65	Conn. Agr. Expt. Sta., Bull. 272, 145 (1925).
Powers-Weightman-Rosengarten Co., Philadelphia, Pa	....	....	30.00	32.78	2.30	0.77	....	64.59	Conn. Agr. Expt. Sta., Bull. 242, 150 (1922).
Riches, Piver & Co., New York, N. Y.	50.00	35.17	15.00	20.02	0.50	0.18	31.00	41.80	Conn. Agr. Expt. Sta., Bull. 272, 145 (1925).
Riches, Piver & Co., New York, N. Y. R. P. & Co	....	0.12	30.00	30.80	1.53	1.20	62.00	64.61	Cal. Dept. Agr., Spec. Pub. 51, 15 (1925).
Schiefelin & Co., New York, N. Y. Powder	....	....	30.00	31.93	1.00	0.20	....	63.50	N. J. Agr. Expt. Sta., Bull. 441, 6 (1926).
W. M. Sheldon, Vacaville, Cal	....	0.21	30.00	30.00	1.00	0.29	....	63.50	Cal. Dept. Agr., Spec. Pub. 34, 15 (1922.)
The Sherwin-Williams Co., Cleveland, Ohio. Sherwin-Williams	....	....	30.00	31.46	1.00	0.23	....	64.48	Conn. Agr. Expt. Sta., Bull. 242, 150 (1922) and Bull. 272, 145 (1925).
The Sherwin-Williams Co., Cleveland, Ohio. Sherwin-Williams, Basic	....	....	....	21.95	0.77	0.13	....	73.38	Cal. Dept. Agr., Spec. Pub. 75, 19 (1927).
D. B. Smith & Co., Utica, N. Y. Lightening	....	....	30.00	31.05	0.77	0.18	....	63.30	Conn. Agr. Expt. Sta., Bull. 272, 145 (1925).
Standard Chemical Works, Reading, Pa. Standard	....	....	31.00	32.86	0.46	0.22	....	64.47	N. J. Agr. Expt. Sta., Bull. 459, 6 (1927).
Toledo Rex Spray Co., Toledo, Ohio. Rex	....	....	15.00	17.45	1.15	0.73	....	34.20	N. J. Agr. Expt. Sta., Bull. 424, 8 (1925).
U. S. Smelting, Refining & Mining Co., Redding, Cal	....	0.20	30.00	32.95	0.75	0.36	63.00	63.45	Cal. Dept. Agr., Spec. Pub. 34, 15 (1922).
Vreeland Chemical Mfg. Co., Little Falls, N. Y. Electro	....	....	30.00	30.24	0.77	0.18	....	64.40	Conn. Agr. Expt. Sta., Bull. 272, 145 (1925).

TABLE III. ARSENITE OF ZINC

Manufacturer or Distributor and Brand	Arsenic, Metal				Publication
	Total		Water-Soluble		
	Guaranteed	Found	Guaranteed	Found	
	%	%	%	%	
California Spray Chemical Co., Watsonville, Cal. Ortho	30.31	30.75	0.38	0.07	Cal. Dept. Agr., Spec. Pub. 34, 16 (1923).
General Chemical Co., New York, N. Y. Orchard	30.50	32.03	1.00	0.24	N. J. Agr. Expt. Sta., Bull. 459, 6 (1927).
Interstate Chemical Co., Jersey City, N. J. Key	30.00	31.44	1.00	0.20	N. J. Agr. Expt. Sta., Bull. 459, 6 (1927).
The Kil-Tone Co., Vineland, N. J. Dry Powdered	29.00	30.80	0.75	0.20	N. J. Agr. Expt. Sta., Bull. 407, 13 (1924).
Lucas Kil-Tone Co., Vineland, N. J. Green Cross	28.40	29.98	0.75	0.16	N. J. Agr. Expt. Sta., Bull. 459, 6 (1927).

Barium Tetrasulphide.

B. T. S. Manufacturer not stated. *Cal. Dept. Agr., Spec. Pub.* 34,34 (1923).

Orchard Brand B. T. S. General Chemical Co., San Francisco, Cal. *Cal. Dept. Agr., Spec. Pub.* 34, 34 (1923).

Solbar. The Bayer Co., New York, N. Y. *Conn. Agr. Expt. Sta., Bull.* 258, 371 (1924).

Analyses:	B.T.S.	Orchard Brand B.T.S.		Solbar.
WATER-SOLUBLE.	Found.	Guaranteed.	Found.	Found.
Total	96.10	....	58.95	59.58
Sulphide sulphur	40.05	....	29.10	15.04
Thiosulphate	3.50	....	1.42	2.55
Total sulphur	43.80	....	30.52	17.59
Barium	....	....	....	43.42
Barium sulphide	....	38-44	57.38	....
Barium thiosulphate	....	1-4	5.54	....
WATER-INSOLUBLE.				
Total	....	....	40.51	....
Silica (S_iO_2)	....	....	9.77	....
Iron and Aluminum Oxide ($Fe_2O_3+Al_2O_3$)	....	....	1.98	....
Ferrous sulphide (FeS)	....	....	0.15	....
Barium sulphite ($BaSO_3$)	....	....	1.01	....
Barium sulphate ($BaSO_4$)	....	....	7.60	....
Free sulphur (S)	....	....	13.61	....
Barium oxide (BaO)	....	....	6.39	....
Carbon dioxide, carbon, etc.	....	....	traces	....
Total sulphur	....	....	....	6.13
Total barium	....	....	....	9.35

Barnes Worm Emulsion.[1]

(S. O. BARNES & SON).

	Guaranteed.	Found.	Guaranteed.	Found.
Water	50.00	94.00	94.00	93.60

Cal. Dept. Agr., Spec. Pub. 75, 64 (1927).

Bayer Dipdust.

Guaranteed: Hydroxymercurichlorphenol sulphate 6.00 per cent; hydroxymercurinitrophenol sulphate 2.00 per cent.

Found: Mercury 5.17 per cent.

Cal. Dept. Agr., Spec. Pub. 75, 62 (1927).

Bean's Bug-Go; Crude.

See "Oil Emulsions, Mineral."

Beck's Flea Powder.

(CHAS. H. BECK MFG. CO., LOS ANGELES, CAL.)

Guaranteed: Talc. 17.50 per cent.

Found: Ash 10.43 per cent.

Cal. Dept. Agr., Spec. Pub. 75, 63 (1927).

Beetle Mort.

See "Green Cross".

[1] Two grades.

Be-Health.

(GENERAL LABORATORIES, MADISON, WIS.)

Guaranteed: Active ingredients 8.50 per cent; inert matter 91.50 per cent.

Found: (grams per 100 cc.) Available chlorine 3.77; total chlorine 3.81; sodium hypochlorite 3.96. Trace of sulphate, no calcium.—*Conn. Agr. Expt. Sta., Bull.* 258, 376 (1924).

Bejo Orchard Spray.

See "Oil Emulsions, Mineral."

B-K Bacili-Kil.

(GENERAL LABORATORIES, MADISON, WIS.)

Guaranteed: Inert matter; calcium chloride 1.71 per cent; water 89.64 per cent.

Found: Available chlorine 3.20 per cent.

Cal. Dept. Agr., Spec. Pub. 75, 61 (1927).

Black Death.

(BLACK DEATH CO., BINGHAMTON, N. Y.)

Found: Carbon 17.11 per cent; sand 5.86 per cent; moisture 10.18 per cent; carbon dioxide 12.39 per cent; sulphur trioxide 23.15 per cent; arsenic trioxide 0.97 per cent; cupric oxide 0.59 per cent; ferric oxide 0.46 per cent; calcium oxide 24.97 per cent; magnesium oxide 5.03 per cent.—*U. S. D. A., Bur. Chem., Bull.* 68, 28 (1902).

Black Leaf 40.

See "Nicotine Sulphate Solutions."

Black Leaf F-2 Nicotine Dust.

See "Nicotine Dusts."

Bleaching Water.

See "Wescco."

Bleach-It.

(GILT EDGE PACKING CO., SAN FRANCISCO, CAL.)

	Guaranteed.	Found.
Available chlorine	4.00	4.99

Cal. Dept. Agr., Spec. Pub. 75, 61 (1927).

Bliss's Bedbug Exterminator.

(FRANK BLISS, ST. LOUIS, MO.)

Found: Borax 20.00 per cent; ether extract 6.79 per cent. A mixture of borax and pyrethrum.— *U. S. D. A., Bur. Chem., Bull.* 68, 43 (1902).

Bliss's Cockroach Exterminator.

(FRANK BLISS, ST. LOUIS, CHICAGO AND CINCINNATI.)

Found: Borax 81.89 per cent. The balance is pyrethrum and pink coloring matter.— *U. S. D. A., Bur. Chem., Bull.* 68, 43 (1902).

Blue Dust.

See "Adheso" and "Sanders."

Blue Label Tonicide.

(MORRIS HERRMANN & CO., NEW YORK, N. Y.)

	Guaranteed.	Found.
Water	....	57.25
Total arsenic, metal	3.70	5.48
Water-soluble arsenic, metal	0.25	0.15
Lead oxide	....	13.51
Copper oxide	....	5.65

N. J. Agr. Expt. Sta., Bull. 301, 13 (1916).

Blue Ribbon Orchard Spray.

See "Oil Emulsions, Mineral."

Borco.

See "Bordeaux Mixture."

Bordeaux Cal-Arsenate, Powdered.

(RICHES, PIVER & CO., NEW YORK, N. Y.)

	Guaranteed.	Found.
Total arsenic, metal	15.00	16.07
Water-soluble arsenic, metal	0.50	0.18
Copper	5.00	4.99

N. J. Agr. Expt. Sta., Bull. 286, 13 (1915).

Bordeaux Dust with Poison.

(MECHLING BROS. CHEMICAL CO., CAMDEN, N. J.)

	Guaranteed.	Found.
Total arsenic, metal	6.00	7.46
Water-soluble arsenic, metal	1.00	0.20
Copper	6.00	7.50

N. J. Agr. Expt. Sta., Bull. 459, 12 (1927).

Bordeaux-Green Powder.

(ANSBACHER INSECTICIDE CO., NEW YORK, N. Y.)

	Guaranteed.	Found.
Total arsenic, metal	11.00	13.82
Water-soluble arsenic, metal	2.25	2.06
Copper	16.00	19.44

N. J. Agr. Expt. Sta., Bull. 286, 11 (1915).

Bordeaux Mixture.

See Table IV.

Bordeaux Mixture—Lead Arsenate.

Tee Table V.

Bordeaux-Paris Green.

(LIGGETT & BRO., NEW YORK, N. Y.)

(See also "Naco-Bordeaux-Paris Green.")

	Guaranteed	Found.
Copper oxide, CuO	17.50	17.37
Total arsenious oxide, As_2O_3	16.50	17.69
Water-soluble arsenious oxide, As_2O_3	2.64	2.72

Conn. Agr. Expt. Sta., Bull. 242, 153 (1922).

TABLE IV. BORDEAUX MIXTURE

Manufacturer or Distributor and Brand	Copper		Calcium Hydroxide—Found	Calcium Carbonate—Found	Inert Calcium Compounds—Guaranteed	Publication
	Guaranteed	Found				
	%	%	%	%	%	
Acme White Lead & Color Works, Detroit, Mich. Acme	12.75	12.72	....	....	....	Cal. Dept. Agr., Spec. Pub. 75, 43 (1927).
Ansbacher Insecticide Co., Inc., New York, N. Y.	16.00	16.27	....	....	....	N. J. Agr. Expt. Sta., Bull. 459, 7 (1927).
James A. Blanchard Co., New York, N. Y. Lion	11.00	14.43	....	....	....	Cal. Dept. Agr., Spec. Pub. 58, 21 (1925).
Bowker Chemical Co., New York, N. Y.	13.00	12.73	....	....	....	N. J. Agr. Expt. Sta., Bull. 441, 7 (1927).
California Rex Spray Co., Benicia, Cal. Borco	17.00	19.63	....	....	....	Cal. Dept. Agr., Spec. Pub. 75, 43 (1927).
California Rex Spray Co., Benicia, Cal. Rex Bordeaux Materials Package 1	25.00	26.06	....	....	....	Cal. Dept. Agr., Spec. Pub. 66, 20 (1926).
California Rex Spray Co., Benicia, Cal. Rex Bordeaux Materials Package No. 2	....	....	91.91	4.30	....	Cal. Dept. Agr., Spec. Pub. 66, 20 (1926).
California Rex Spray Co., Benicia, Cal. Rex Bordeaux Powder	12.75	13.08	....	....	....	Cal. Dept. Agr., Spec. Pub. 66, 20 (1926).
California Spray Chemical Co., Watsonville, Cal. Ortho	12.75	13.58	....	....	....	Cal. Dept. Agr., Spec. Pub. 75, 43 (1927).
Chipman Chemical Engineering Co., Bound Brook, N. J.	12.50	12.50	....	....	....	Ore. Agr. Expt. Sta., Cir. 84, 12 (1927).
Devoe & Raynolds, New York, N. Y.	18.00	11.15	....	....	....	Ore. Agr. Expt. Sta., Cir. 84, 12 (1927).
Dow Chemical Co., Midland, Mich. Dow Powdered Magnesium Bordo	25.00	24.99	....	....	75.00	Cal. Dept. Agr., Spec. Pub. 34, 22 (1922).
E-Z Way Co., Oakland, Cal. E-Z Burgundy	15.30	11.86	....	....	....	Cal. Dept. Agr., Spec. Pub. 58, 21 (1925).
F. A. Frazier Co., Pt. Richmond, Cal. Dosch Copper Lime Dust	3.50	4.48	....	....	90.00	Cal. Dept. Agr., Spec. Pub. 34, 23 (1922).
F. A. Frazier Co., Pt. Richmond, Cal. Dosch Copper Lime Dust	2.54	2.84	....	....	90.00	Cal. Dept. Agr., Spec. Pub. 34, 23 (1922).
F. A. Frazier Co., Pt. Richmond, Cal. Frazier's Bordo "A"	24.00	24.49	....	....	....	Cal. Dept. Agr., Spec. Pub. 58, 21 (1925).
F. A. Frazier Co., Pt. Richmond, Cal. Frazier's Bordo "A"	24.50	24.64	....	....	....	Cal. Dept. Agr., Spec. Pub. 58, 21 (1925).

F. A. Frazier Co., Pt. Richmond, Cal. Frazier's Bordo "B"	....	....	93.96	....	....	Cal. Dept. Agr., Spec. Pub. 58, 21 (1925).
General Chemical Co., New York, N. Y. Orchard	12.50	12.31	....	....	....	Cal. Dept. Agr., Spec. Pub. 75, 43 (1927).
The Glidden Co., Cleveland, Ohio. Glidden	16.00	15.24	....	....	....	Cal. Dept. Agr., Spec. Pub. 58, 22 (1925).
The Glidden Co., Cleveland, Ohio. Glidden Dry Powdered	22.00	18.85	....	....	....	Cal. Dept. Agr., Spec. Pub. 58, 22 (1925).
The Grasselli Chemical Co., Cleveland, Ohio	13.00	14.78	....	....	....	Conn. Agr. Expt. Sta., Bull. 242, 153 (1922).
Hammond's Paint & Slug Shot Works, Beacon, N. Y. Pulp[1]	5.50	4.15	....	....	....	N. J. Agr. Expt. Sta., Bull. 441, 7 (1926).
Hood River Spray Co., Hood River, Ore[2]	24.00	24.60	....	....	....	Ore. Agr. Expt. Sta., Cir. 84, 12 (1927).
J. H. Howell, Planada, Cal. Dried Bordeaux Paste	....	19.80	....	....	....	Cal. Dept. Agr., Spec. Pub. 34, 23 (1922).
Interstate Chemical Co., Jersey City, N. J. Key	12.50	14.58	....	....	....	N. J. Agr. Expt. Sta., Bull. 459, 7 (1927).
The Kil-Tone Co., Vineland, N. J. Modified Kil-Tone[3]	8.00	11.91	....	....	....	N. J. Agr. Expt. Sta., Bull. 407, 9 (1924).
The Kil-Tone Co., Vineland, N. J. Modified Kil-Tone, Dry Form	22.50	23.20	....	....	....	N. J. Agr. Expt. Sta., Bull. 407, 9 (1924).
Kirk, Geary & Co., Sacramento, Cal. Paste[4]	....	....	....	....	....	Cal. Dept. Agr., Spec. Pub. 51, 19 (1925).
Leggett & Bro., New York, N. Y. Anchor[5]	4.50	4.79	....	....	....	Conn. Agr. Expt. Sta., Bull. 242, 153 (1922).
John Lucas & Co., Inc., Philadelphia, Pa. Bordo Mixture Dry Powder 25%	25.00	27.14	....	....	....	N. J. Agr. Expt. Sta., Bull. 407, 9 (1924).
John Lucas & Co., Inc., Philadelphia, Pa. Lucas Dry Powdered[4]	16.00	15.84	....	....	....	Cal. Dept. Agr., Spec. Pub. 75, 43 (1927).
Lucas-Kil-Tone Co., Vineland, N. J. Green Cross	21.50	21.28	....	....	....	N. J. Agr. Expt. Sta., Bull. 459, 7 (1927).
Lucas-Kil-Tone Co., Vineland, N. J. Green Cross Dry Bordo	22.00	25.44	....	....	....	N. J. Agr. Expt. Sta., Bull. 459, 7 (1927).
Mechling Bros. Chemical Co., Camden, N. J.	12.50	12.73	....	....	....	N. J. Agr. Expt. Sta., Bull. 459, 7 (1927).
Mechling Bros. Chemical Co., Camden, N. J. Powder	16.00	17.80	....	....	....	N. J. Agr. Expt. Sta., Bull. 441, 7 (1926).
Miller Products Co., Portland, Ore.[2]	24.00	25.20	....	....	....	Lrc. Agr. Expt. Sta., Cir. 84, 12 (1927).
Montgomery, Ward & Co., Portland, Ore.	14.00	12.50	....	....	....	Ore. Agr. Expt. Sta., Cir. 84, 12 (1927).
National Chemical Co., Pittsburg, Pa. National Bordo "A"	24.00	24.90	....	....	....	Cal. Dept. Agr., Spec. Pub. 75, 43 (1927).

[1] 68.64% water.

[2] A two powder preparation. One package contains partially dehydrated copper sulphate, the other hydrated lime. Copper is reported as found in the copper sulphate package.

[3] 50.71% water.

[4] Decomposed.

[5] 58.03% water.

TABLE IV. BORDEAUX MIXTURE—*Concluded.*

Manufacturer or Distributor and Brand	Copper		Calcium Hydroxide—Found	Calcium Carbonate—Found	Inert Calcium Compounds—Guaranteed	Publication
	Guaranteed	Found				
	%	%	%	%	%	
National Chemical Co., Pittsburg, Pa. National Bordo "B"	....	....	93.70[6]	....	....	Cal. Dept. Agr., Spec. Pub. 75, 43 (1927).
Chas. C. Navlet Co., Inc., San Jose, Cal. Navco Powder	12.75	10.79	....	....	....	Cal. Dept. Agr., Spec. Pub. 58, 22 (1925).
Chas. C. Navlet Co., Inc., San Jose, Cal. Navco Home-made Bordeaux	24.00	24.35	....	....	....	Cal. Dept. Agr., Spec. Pub. 58, 22 (1925).
Chas. C. Navlet Co., Inc., San Jose, Cal. Navco Home-mixed Bordeaux Package No. 1	24.00	24.26	....	....	....	Cal. Dept. Agr., Spec. Pub. 58, 22 (1925).
Chas. C. Navlet Co., Inc., San Jose, Cal. Navco Home-mixed Bordeaux Package No. 2	....	....	93.91	....	....	Cal. Dept. Agr., Spec. Pub. 58, 22 (1925).
Nitrate Agencies Co., Bayonne, N. J.	13.00	14.14	....	....	....	N. J. Agr. Expt. Sta., Bull. 459, 7 (1927).
Pittsburgh Plate Glass Co., Newark, N. J. Corona Dry	18.00	20.34	....	....	....	Cal. Dept. Agr., Spec. Pub. 75, 43 (1927).
Riches, Piver & Co., New York, N. Y.	15.00	17.50	....	....	....	N. J. Agr. Expt. Sta., Bull. 407, 9 (1924).
San Jose Spray Mfg. Co., San Jose, Cal.	12.75	11.51	....	....	....	Cal. Dept. Agr., Spec. Pub. 58, 22 (1925).
San Jose Spray Mfg. Co., San Jose, Cal. Twin Bordeaux, Package 1	24.00	25.09	....	....	....	Cal. Dept. Agr., Spec. Pub. 66, 20 (1926).
San Jose Spray Mfg. Co., San Jose, Cal. Twin Bordeaux, Package 2	....	....	....	83.32	12.70	Cal. Dept. Agr., Spec. Pub. 66, 20 (1926).
Sherwin-Williams Co., Cleveland, Ohio. Fungi-Bordo	12.75	12.90	....	....	....	Cal. Dept. Agr., Spec. Pub. 75, 43 (1927).
Sherwin-Williams Co., Cleveland, Ohio. Hemming-way Dry	12.75	13.13	....	....	....	Cal. Dept. Agr., Spec. Pub. 66, 20 (1926).
Sterling Chemical Co., Cambridge, Mass. Sterling-worth	10.00	11.96	....	....	....	Conn. Agr. Expt. Sta., Bull. 242, 153 (1922).
Vreeland Chemical Mfg. Co., Little Falls, N. J. Electro	18.00	19.78	....	....	....	N. J. Agr. Expt. Sta., Bull. 424, 9 (1925).

[6] Hydrated-magnesia spreader. Guaranteed hydrated lime with casein spreader, 100 per cent.

Bordeaux Zinc.

(THOMSEN CHEMICAL CO., BALTIMORE, MD.)

	Guaranteed.	Found.
Water	....	53.02
Total arsenic, metal	7.63	7.53
Water-soluble arsenic, metal	0.57	0.08
Copper	4.50	4.57

N. J. Agr. Expt. Sta., Bull. 286, 13 (1915).

Bordeth.

(KILTONE CO., NEWARK, N. J.)

	Guaranteed.	Found.
Total arsenic oxide	20.00	18.01
Water-soluble arsenic oxide	1.00	0.28
Copper hydroxide	15.00	15.44

N. J. Agr. Expt. Sta., Bull. 273, 12 (1914).

Borecide.

(MASON DRUG & CHEMICAL CO., HANCOCK, MD).

Found: Ash 58.14 per cent; loss on ignition 41.86 per cent; insoluble in boiling water 65.35 per cent; melting-point of sublimate, 31.0° C. The substance had the odor of naphthalene, and the sublimate combined with picric acid, but the melting-point was nearer that of methyl naphthalene.—*Conn. Agr. Expt. Sta., Bull.* 242, 160 (1924).

Boxal.

(BOWKER INSECTICIDE CO., BOSTON, MASS.)

Found: Copper 12.08 per cent; arsenious oxide 13.52 per cent.—*N. Y. Agr. Expt. Sta., Bull.* 384, 289 (1914).

Brazilian Insecticide Powder.

(I. MAJORA CO. ALA MARA, BRAZIL.)

Found: Borax 8.84 per cent; sodium carbonate 37.52 per cent; sulphur 13.57 per cent. Balance pyrethrum and ultramarine.—*U. S. D. A., Bur. Chem., Bull.* 68, 43 (1902).

Brininstool's Coal Tar Creosote.

(THE BRININSTOOL CO.)

Found: Oils 94.80 per cent, phenols 3.90 per cent, trace of water and ash, no rosin. Baumé gravity of separated oil, 17.3; per cent unsulphonated oil, 24.60—*Cal. Dept. Agr., Spec. Pub.* 51, 45 (1925).

Brown's Pink Powder Insecticide.

(BROWN'S INSECTICIDE CO., SYRACUSE, N. Y.)

Found: Borax 88.55 per cent. Balance cloves and pink coloring matter.—*U. S. D. A., Bur. Chem., Bull.* 68, 43 (1902).

Brunswig Squirrel Annihilator.

See "Strychnine Preparations".

Bug and Blight Dust.

(LEGGETT & BRO., NEW YORK, N. Y.)

	Guaranteed.	Found.
Total arsenic, metal	16.00	16.21
Water-soluble arsenic, metal	3.00	2.25
Copper	6.00	6.44

N. J. Agr. Expt. Sta., Bull. 273, 12 (1914).

TABLE V. BORDEAUX MIXTURE—LEAD ARSENATE

Manufacturer or Distributor and Brand	Arsenic Oxide, As_2O_5				Copper, (Cu)		Lead Oxide, (PbO)		Water	Publication
	Total		Water-Soluble							
	Guaranteed	Found	Guaranteed	Found	Guaranteed	Found	Guaranteed	Found	Found	
	%	%	%	%	%	%	%	%	%	
Acme White Lead & Color Works, Detroit, Mich. Acme 2-way Spray	4.29	5.11	0.46	0.31	11.00	11.25	....	9.28	....	Cal. Dept. Agr., Spec. Pub. 75, 44 (1927).
Bowker Chemical Co., New York, N. Y. Bowker's Dry Powdered Bordeaux Arsenate	7.96	8.11	0.77	0.41	15.00	14.62	....	....	....	N. J. Agr. Expt. Sta., Bull. 407, 12 (1924).
Bowker Chemical Co., New York, N. Y. Pyrox	5.00	5.57	0.46	0.06	....	6.70	....	1.28	65.95	Conn. Agr. Expt. Sta., Bull. 272, 146 (1925).
California Sprayer Co. Calispray Dust No. 86	13.46	13.92	1.15	0.44	3.80	4.45	....	27.67	....	Cal. Dept. Agr., Spec. Pub. 75, 44 (1927).
Chipman Chemical & Engineering Co., New York, N. Y. Bordo-Lead	7.29	8.73	0.38	0.18	....	16.47	....	15.24	....	Conn. Agr. Expt. Sta., Bull. 272, 146 (1925).
General Chemical Co., New York, N. Y. Orchard Bordeaux Lead	9.37	10.25	1.50	0.06	15.00	15.95	....	....	....	N. J. Agr. Expt. Sta., Bull. 459, 10 (1927).
The Glidden Co., Cleveland, Ohio, Glidden Bordo-Arsenate	15.50	17.54	0.50	0.20	....	9.32	....	31.71	....	Conn. Agr. Expt. Sta., Bull. 242, 154 (1922).
The Glidden Co., Cleveland, Ohio. Glidden Bordo-Arsenate	5.90	14.77	0.50	0.18	....	13.31	....	26.64	....	Conn. Agr. Expt. Sta., Bull. 272, 146 (1925).
Interstate Chemical Co., Jersey City, N. J. Key Bordo-Lead	4.45	6.65	0.77	0.60	....	6.05	....	13.76	60.85	Conn. Agr. Expt. Sta., Bull. 242, 153 (1922).
Interstate Chemical Co., Jersey City, N. J. Key Bordo-Lead	7.67	7.82	0.77	0.09	....	2.99	....	....	60.83	Conn. Agr. Expt. Sta., Bull. 242, 153 (1922).
Interstate Chemical Co., Jersey City, N. J. Key-Cide	4.22	5.75	....	0.18	10.00	10.06	....	9.90	....	Conn. Agr. Expt. Sta., Bull. 242, 158 (1922).

Riches, Piver & Co., New York, N. Y. Ceres Bordeaux-Lead Powdered	5.20	8.02	0.77	0.86	11.59	11.65	....	....	....	N. J. Agr. Expt. Sta., Bull. 424, 16 (1925).
Sherwin-Williams Co., Cleveland, Ohio. Pestroy	4.28	3.52	0.46	0.32	11.00	11.02	....	6.61	....	Cal. Dept. Agr., Spec. Pub. 75, 44 (1927).
Skinner Machinery Co., Dunedin, Fla. Skinner's Arsenate Bordeaux	26.01	28.25	....	0.28	4.00	2.64	....	....	....	N. J. Agr. Expt. Sta., Bull. 407, 16 (1924).
H. J. Smith Co., Utica, N. Y. Hexpo	6.90	8.37	0.50	0.28	....	18.07	....	18.89	....	Conn. Agr. Expt. Sta., Bull. 272, 146 (1925).
H. J. Smith Co., Utica, N. Y. Hexpo	6.88	7.33	0.50	0.57	15.40	19.27	....	14.33	....	Conn. Agr. Expt. Sta., Bull. 242, 158 (1922)
Vreeland Chemical Mfg. Co., New York, N. Y. Bordo-Lead Mixture	5.58	8.91	0.78	0.11	....	2.57	....	18.32	44.23	Conn. Agr. Expt. Sta., Bull. 272, 146 (1925)

Bug Death.

(DANFORTH CHEMICAL CO., LEOMINSTER, MASS.)

	Guaranteed.	Found.
Zinc oxide	47.00	54.15
Lead oxide	5.00	14.11

Conn. Agr. Expt. Sta., Bull. 242, 159 (1922).

Bug Death Alpha.

(DANFORTH CHEMICAL CO., LEOMINSTER, MASS.)

	Guaranteed.	Found.
Nicotine	0.05	trace
Sulphur	20.00	18.20
Zinc oxide	15.00	16.50
Lead oxide	1.00	4.80

Ore. Agr. Expt. Sta., Cir. 84, 11 (1927).

Bug Death Aphis.

(DANFORTH CHEMICAL CO., LEOMINSTER, MASS.)

	Guaranteed.	Found.
Nicotine	0.05	present
Sulphur	20.00	19.29
Zinc oxide	15.00	23.63
Lead oxide	1.00	5.69

Maine Agr. Expt. Sta., Official Inspections 110, 55 (1923).

Bug Dope.

(H. J. SMITH & CO., UTICA, N. Y.)

	Guaranteed.	Found.
Total arsenic, metal	0.37	0.62
Water-soluble arsenic, metal	2.70	0.23
Copper	....	0.30

N. J. Agr. Expt. Sta., Bull. 286, 13 (1915).

Buhack Insect Powder.

See "Pyrethrum".

Buker's Sheep Dip.

See "Phenol Soap Solutions".

By-Sul.

(GEO. H. CORSE, JR. & CO., SAN FRANCISCO, CAL.)

Two samples:

Sample 1.

Guaranteed: Carbon disulphide 41.00 per cent; inert matter 52.00 per cent.

Found: Carbon disulphide 37.98 per cent; water 50.82 per cent; calcium carbonate 4.06 per cent; calcium polysulphide 6.06 per cent.

Sample 2.

Guaranteed: Carbon disulphide 41.48 per cent; inert matter 52.59 per cent.

Found: Carbon disulphide 46.20 per cent; water 46.00 per cent; clay and oil 6.18 per cent; calcium polysulphide none.

Cal. Dept. Agr., Spec. Pub. 51, 60 (1925).

Caascu.

(HEMINGWAY & CO., INC., BOUND BROOK, N. J.)

	Guaranteed.	Found.
Total arsenic, metal	16.00	18.23
Water-soluble arsenic, metal	4.00	0.12
Copper	....	7.73

N. J. Agr. Expt. Sta., Bull. 459, 11 (1927).

Caasen.

(HEMINGWAY LONDON PURPLE CO., LONDON & NEW YORK).

Found: Arsenious oxide 34.13 per cent; copper 8.10 per cent.

N. Y. Agr. Expt. Sta., Bull. 384, 301 (1914).

Cabot's Gypsy Moth Creosote.

(SAMUEL CABOT, INC., BOSTON, MASS.)

Guaranteed: Not more than 10 per cent inert matter.

Found: Substance is composed of tarry matter like gas-house wastes. There are no oils present.

Maine Agr. Expt. Sta., Official Inspections 114, 88 (1924).

Calcium Arsenate.

See "Arsenate of Calcium".

Calcium Caseinate.

See Table VI.

Calcium Cyanide.

See Table VII.

Calcium Fluosilicate Compound.

(VICTOR CHEMICAL WORKS, NEW YORK, N. Y.)

Guaranteed: Calcium fluosilicate not less than 15 per cent; inert matter not over 85 per cent.

Found: Phosphorus pentoxide 28.37 per cent; calcium oxide 21.80 per cent; iron and aluminum oxides 20.60 per cent; silica 11.00 per cent; fluorine 11.95 per cent.

Conn. Agr. Expt. Sta., Bull. 272, 149 (1925).

Calco-Green.

(Manufacturer not stated).

Found: Total arsenious oxide 30.0 per cent; water-soluble arsenious oxide 7.0 per cent.

Univ. of Cal., Coll. of Agr., Expt. Sta., Bull. 151, 24 (1903).

Calcyco Braun Gas.

Calcyco Hydrocyanic Acid.

See "Hydrocyanic Acid".

California C & G Brand Bleaching Water.

(CALIFORNIA BLEACHING WATER CO., SAN FRANCISCO, CAL.)

	Guaranteed.	Found.
Available chlorine	4.00	5.17

Cal. Dept. Agr., Spec. Pub. 75, 61 (1927).

TABLE VI—CALCIUM CASEINATE

Manufacturer or Distributor and Brand	Nitrogen	Casein N x 6.38	Calcium Oxide CaO	Publication
	%	%	%	
California Central Creameries, San Francisco, Cal. Kayso	3.28	20.93	46.29	Conn. Agr. Expt. Sta., Bull. 258, 369 (1924); 272, 149 (1925).
Casein Mfg. Co., New York, N. Y. A-7-ML	7.92	50.53	27.27	Conn. Agr. Expt. Sta., Bull. 258, 369 (1924).
Rosin & Co., Philadelphia, Pa. Red Diamond	3.31	21.12	50.64	Conn. Agr. Expt. Sta., Bull. 258, 369 (1924).

TRBLE VII. CALCIUM CYANIDE

Manufacturer or Distributor and Brand	Cyanogen, CN		Calcium, Ca.	Chlorine, Cl.	Calcium Cyanide, $Ca(CN)_2$		Publication
	Guaranteed	Found			Guaranteed	Found	
	%	%	%	%	%	%	
American Cyanamid Co., New York, N. Y. G Grade	40.00	40.30	....	....	....	71.35	N. J. Agr. Expt. Sta., Bull. 424, 12 (1925).
American Cyanamid Co., New York, N. Y. Cyanogas	....	....	....	....	40.00	43.17	Cal. Dept. Agr., Spec. Pub. 75, 61 (1927).
California Cyanide Co., Southgate, Cal. Calcanide Fumigant Grade No. 1	....	....	....	....	88.00	91.73	Cal. Dept. Agr., Spec. Pub. 75, 61 (1927).
California Cyanide Co., Southgate, Cal. Cal-Sy	....	....	....	....	25.00	27.73	Cal. Dept. Agr., Spec. Pub. 75, 61 (1927).
California Cyanide Co., Southgate, Cal. Citrofume Citrus Fumigant	....	....	....	....	53.00	54.30	Cal. Dept. Agr., Spec. Pub. 75, 61 (1927).
L. E. Neville, Los Angeles, Cal. Aero Rodent Exterminator	20.00	23.71	32.77	43.68	....	41.98	Cal. Dept. Agr., Spec. Pub. 34, 57 (1923).

California Spray.

(UNITED STATES SPRAY CO., SAN BERNARDINO, CAL.)

Guaranteed: Inert matter 65.00 per cent.

Found: Oils 29.00 per cent; inert matter 69.00 per cent. Sodium fluoride and rosin present.

Cal. Dept. Agr., Spec. Pub. 34, 37 (1923).

Calispray Combined Insecticide and Fungicide Dust No. 3.

See "Nicotine-Sulphur Dusts".

Calispray Complete Garden Dust No. 83.

(CALIFORNIA SPRAYER CO.)

	Guaranteed.	Found.
Nicotine	1.25	0.85
Total arsenic, metal	1.76	1.69
Water-soluble arsenic, metal	0.50	0.26
Lead oxide	....	8.17
Sulphur	50.00	46.95

Cal. Dept. Agr., Spec. Pub. 75, 38 (1927).

Calispray Dust No. 1.

Calispray Dust No. 2.

See "Nicotine-Sulphur Dusts".

Calispray Dust No. 12.

See "Nicotine Dusts".

Calispray Dust No. 86.

See "Bordeaux Mixture-Lead Arsenate".

Calispray Insecticide Dust No. 11.

Calispray Insecticide Dust No. 15.

See "Nicotine Dusts".

Calispray Insecticide Dust No. 81.[1]

(CALIFORNIA SPRAYER CO.)

	Guaranteed.	Found.	Guaranteed.	Found.
Nicotine	2.00	2.21	2.00	2.28
Total arsenic, metal	3.50	3.39	3.80	4.06
Water-soluble arsenic, metal	0.50	0.18	0.50	0.29
Lead oxide	....	13.87	....	13.02

Cal. Dept. Agr., Spec. Pub. 75, 38 (1927).

Calispray Nico-Dust No. 82

(CALIFORNIA SPRAYER CO.)

	Guaranteed.	Found.
Nicotine	2.50	1.22
Total arsenic, metal	3.50	4.30
Water-soluble arsenic, metal	0.50	0.46
Lead oxide	....	12.76
Copper	5.00	4.85

Cal. Dept. Agr., Spec. Pub. 75, 38 (1927).

[1] Two samples.

Calite.

(MORRIS HERRMANN & CO., NEW YORK, N. Y.)

	Guaranteed.	Found.
Total arsenic, metal	11.40	11.55
Water-soluble arsenic, metal	0.5	0.45
Water	....	67.07

Mich. Agr. Coll. Expt. Sta., Spec. Bull. 74, 10 (1915).

Calox.

See "Oil Emulsions, Mineral".

Calpest Garden Dust.

See "Nicotine Dusts".

Calpest Sow Bug Killer.

(CALIFORNIA PEST CONTROL CO., BURLINGAME, CAL.)

Guaranteed: Copper aceto-arsenite, 8.00 per cent.
Found: Arsenious oxide, 11.04 per cent.
Cal. Dept. Agr., Spec. Pub. 75, 26 (1927).

Calpest Summer Spray.

See "Oil Emulsions, Mineral".

Calpest Weed Killer.

(CALIFORNIA PEST CONTROL CO., BURLINGAME, CAL.)

	Guaranteed.	Found.
Arsenious oxide	30.00	31.30

Cal. Dept. Agr., Spec. Pub. 75, 25 (1927).

Calpest Whale Oil Soap.

See "Soaps".

Calpro Ant Syrup.

(THE CALPRO SALES CO., LOS ANGELS CAL.)

	Guaranteed.	Found.
Arsenic, metal	0.10	0.22

Cal. Dept. Agr., Spec. Pub. 75, 24 (1927).

Cal-Sy.

See "Calcium Cyanide".

Cann's Ant Exterminator.

(ARTHUR CANN CO., SAN JOSE, CAL.

Guaranteed: Inert matter 10.00 per cent.
Found: Phenols 12.20 per cent, inert matter 9.60 per cent. Rosin present.
Cal. Dept. Agr., Spec. Pub. 34, 36 (1923).

Cann's Canco.

See "Phenol Soap Solutions".

Cann's Carco.

(ARTHUR CANN CO., SAN JOSE, CAL.)

Found: Phenols 7.30 per cent. Rosin present.
Cal. Dept. Agr., Spec. Pub. 34, 36 (1923).

Capital Sheep Dip and Cattle Wash.

See "Phenol Soap Solutions".

Capital Squirrel Poison.

See "Strychnine Preparations".

Carboleine, Pratt's.

See "Oil Emulsions, Mineral".

Carbolic Acid.

See "Phenol".

Carbolicide.

See "Hockwald".

Carbolineum.

See "Avenarius Carbolineum".

Carbon Disulphide.

See Table VIII.

Carbon Disulphide Emulsion.

(I. P. THOMAS & SON CO., PHILADELPHIA, PA.)

Found: Carbon Disulphide 68.62 per cent.

Conn. Agr. Expt. Sta., Sample 3893.

Carbo-White Disinfectant.

(R. L. STEVENS BROKERAGE CO., SAN FRANCISCO, CAL.)

Found: Phenols 1.40 per cent; organic matter, partly glue and water, 6.50 per cent; mineral matter, mostly calcium carbonate, 92.10 per cent.

Cal. Dept. Agr., Spec. Pub. 51, 58 (1925).

Carco.

(SUNSET SALES CO., TACOMA, WASH.)

Carco.

(See also "Cann's Carco".)

Claimed phenols, soap and hydrocarbons present.

Ore. Agr. Expt. Sta., Cir. 64, 15 (1925).

Carco Natholeum Dip.

See "Phenol Soap Solutions".

Caustic Soda Arctic Whale Oil Soap.

See "Soaps".

Cedar Blocks.

See "Paradichlorbenzene".

"Cee-Pee-Dee" Carbolized Petroleum Distillate.

See "Oil Emulsions, Mineral".

Cenol Ant Destroyer.

(CENTRAL CITY CHEMICAL CO., SAN FRANCISCO, CAL.)

	Guaranteed.	Found.
Sodium fluoride	25.00	30.82
Ash	....	1.00

Cal. Dept. Agr., Spec. Pub. 75, 63 (1927).

TABLE VIII. CARBON DISULPHIDE

Manufacturer or Distributor	Carbon Disulphide, CS_2		Residue on Evaporation	Hydrogen Sulphide	Publication
	Guaranteed	Found			
	%	%	%	%	
Brunswig Drug Co.	99.00	99.56	0.02	none	Cal. Dept. Agr., Spec. Pub. 51, 47 (1925).
Sun Drug Co., Pasadena, Cal.	97.00	98.50	0.02	none	Cal. Dept. Agr., Spec. Pub. 51, 47 (1925).
Herbert F. Dugan, San Francisco, Cal. Kilmol Squirrel-gophene[1]	99.22	99.23	....	....	Cal. Dept. Agr., Spec. Pub. 66, 36 (1926).
Towne-Allison Drug Co., San Bernardino, Cal.	....	99.90	0.09[2]	none	Cal. Dept. Agr., Spec. Pub. 51, 47 (1925).
Western Wholesale Drug Co., Los Angeles, Cal.	97.00	99.94	0.03[3]	none	Cal. Dept. Agr., Spec. Pub. 51, 47 (1925).
Wheeler, Reynolds & Stauffer, San Francisco, Cal.	99.98	99.97	....	none	Cal. Dept. Agr., Spec. Pub. 51, 47 (1925).
Wheeler, Reynolds & Stauffer, San Francisco, Cal.	97.00	97.18	2.25	present	Cal. Dept. Agr., Spec. Pub. 51, 47 (1925).

[1] Free sulphur guaranteed 0.08 per cent; found 0.10 per cent. Irritant chemicals dissolved in oil, guaranteed 0.70 per cent; found 0.67 per cent.

[2] Chiefly ferric oxide.

[3] Guaranteed not more than 3.00 per cent.

Cenol Argentine Ant Poison.

(CENTRAL CITY CHEMICAL CO., SAN FRANCISCO, CAL.)

	Guaranteed.	Found.
Arsenic, metal	0.11	0.17

Cal. Dept. Agr., Spec. Pub. 75, 24 (1927).

Cespi Poisoned Barley.

Cespi Poisoned Wheat.

See "Strychnine Preparations".

Cespi Rat Poison.

(SCOTT & GILBERT CO., SAN FRANCISCO, CAL.)

	Guaranteed.	Found.
Barium carbonate	95.00	98.06

Cal. Dept., Agr., Spec. Pub. 75, 66 (1927).

Chemco Insect & Germ Destroyer.

See "Oils, Mineral".

Chlorafectant.

(AMERICAN OIL CO., NEW YORK.

	Guaranteed.	Found.
Sodium hypochlorite	4.0	3.55

Conn. Agr. Expt. Sta., Sample 516.

Chloride of Lime.

(GREAT WESTERN ELECTRO CHEMICAL CO.)

Available chlorine	30.00	35.26

(WESTERN WHOLESALE DRUG COMPANY)

	Guaranteed.	Found.
Available chlorine	....	34.30

Cal. Dept. Agr., Spec. Pub. 51, 53 (1925).

Chloro Naptholeum.

(WEST DISINFECTING CO., NEW YORK, N.Y.)

A creosote oil and napthalene soap emulsion.

U. S. D. A., Bur. Chem., Bull. 68, 58 (1902).

Citro-Mulsion.

See "Oil Emulsions, Mineral".

Citrospray.

(CITROSPRAY CHEMICAL CO. LTD., LOS ANGELES, CAL.)

	Guaranteed.	Found.
Total arsenic, metal	4.50	4.31
Water-soluble arsenic, metal	1.00	1.48
Lead oxide	12.50	12.89
Sulphur	20.00	19.17
Sodium oxide	13.00	....
Sodium carbonate	....	27.56
Sodium oleate	16.50	8.20
Sodium phosphate	10.00	7.16
Water	....	19.58
Inert matter	23.50	....

Cal. Dept. Agr., Spec. Pub. 58, 19 (1925).

Citrus Washing Powder.

See "Soaps".

Clay.

(COLLODITE MFG. CO., LOS ANGELES, CAL.)

The clay used in the manufacture of "Collodite" sprays.

Found: Water 9.60 per cent; silica 60.90 per cent; aluminum oxide 19.77 per cent; ferric oxide 1.15 per cent; calcium oxide 0.22 per cent; magnesium oxide 0.57 per cent; sulphur trioxide 0.22 per cent; sodium and potassium oxides 0.77 per cent; water of constitution 6.80 per cent.

Cal. Dept. Agr., Spec. Pub. 34, 61 (1923).

Clensel.

See "Soaps".

Clorox Liquid Cleaning Compound.

(CLOROX CHEMICAL CORPORATION, OAKLAND, CAL.)

	Guaranteed.	Found.
Available chlorine	4.50	5.50

Cal. Dept. Agr., Spec. Pub. 75, 61 (1927).

Clumina.

(L. S. B. A. I., ROME, ITALY).

Found: Free chlorine 0.004 per cent; total chlorine 1.08 per cent.

Cal. Dept. Agr., Spec. Pub. 66, 35 (1926).

C. N.

See "Coro Noleum".

Coal Tar Insecticide Oil.

(SCOTT & GILBERT CO., SAN FRANCISCO, CAL.)

	Guaranteed.	Found.
Phenols	40.00	39.00
Coal-tar oils	55.00	59.30
Water	2.00	1.60

Cal. Dept. Agr., Spec. Pub. 75, 56 (1927).

Collodite Arsenical Spray.

(COLLODITE SPRAY MFG. CO., LOS ANGELES, CAL.)

Found: Total arsenic oxide 8.87 per cent; water-soluble arsenic oxide 1.89 per cent. Contains calcium arsenate.

Cal. Dept. Agr., Spec. Pub. 34, 61 (1923).

Collodite Copper Spray.

(COLLODITE MFG. CO., LOS ANGELES, CAL.)

Found: Copper 5.26 per cent.

Cal. Dept. Agr., Spec. Pub. 34, 62 (1923).

Collodite Nicotine Spray.

(COLLODITE MFG. CO., LOS ANGELES, CAL.)

Found: Nicotine 2.93 per cent; sodium carbonate 37.10 per cent.

Cal. Dept. Agr., Spec. Pub. 34, 62 (1923).

Collodite Rosin Paste.

(COLLODITE MFG. CO., LOS ANGELES, CAL.)

	Guaranteed.	Found.
Water	36.00	29.40

Cal. Dept. Agr., Spec. Pub. 58, 46 (1925).

Collodite Scale Spray.

(COLLODITE MFG. CO., LOS ANGELES, CAL.)

Found: Sodium carbonate 28.19 per cent; soap 4.50 per cent; sulphur 2.16 per cent.

Cal. Dept. Agr., Spec. Pub. 34, 61 (1923).

Collodite Sulfur Spray.

(COLLODITE MFG. CO., LOS ANGELES, CAL.)

Found: Sulphur 25.44 per cent; soda ash large.

Cal. Dept. Agr., Spec. Pub. 34, 26 (1923).

Columbian Insecticide.

(COLUMBIAN INSECTICIDE CO., BOSTON, MASS.)

Found: Borax 94.74 per cent; sand 2.52 per cent; cloves 3.28 per cent. Blue coloring matter present.

U. S. D. A., Bur. Chem., Bull. 68, 43 (1902).

Common Sense Rat Exterminator.

See "Phosphorus Preparations".

Concentrated Adheso Yellow Label.

(ANSBACHER INSECTICIDE CO., INC., NEW YORK, N.Y.)

	Guaranteed.	Found.
Copper	10.38	13.84
Water	....	52.02

N. J. Agr. Expt. Sta., Bull. 441, 10 (1926).

Condensed Rosin Spray.

See "Soap".

Conkey's Noxicide.

See "Phenol Soap Solutions".

Conkey's Poultry Worm Remedy.

(THE G. E. CONKEY CO., CLEVELAND, OHIO.)

Guaranteed: Pelletierine 0.200 per cent; arecoline 0.020 per cent; nicotine 0.100 per cent; oil of chenopodium 0.120 per cent.

Found: Nicotine 0.22 per cent.

Cal. Dept. Agr., Spec. Pub. 75, 65 (1927).

Cooper's Sheep Dipping Powder.

(S. COOPER & NEPHEWS, CHICAGO, ILL.)

	Guaranteed.	Found.
Total arsenic, metal	16.75	14.00
Water-soluble arsenic, metal	17.48	14.18

Maine Agr., Expt. Sta., Official Inspections 114, 88 (1924).

Copodust.

(NIAGARA SPRAYER CO., MIDDLEPORT, N. Y.)

	Guaranteed.	Found.
Copper sulphate	14.0	12.0

Ore. Agr. Expt. Sta., Cir. 64, 11 (1925).

Copotex.

See "Niagara Copotox".

Copper-Calcium Arsenate Dust, 13-8-79.

(DORCH CHEMICAL CO., LOUISVILLE, KY.)

	Guaranteed.	Found.
Total arsenic oxide	3.00	1.39
Water-soluble arsenic, metal	0.50	....
Copper	4.40	5.20

Conn. Agr. Expt. Sta., Bull. 242, 152 (1925).

Copper Carbonate.

See Table IX.

Copper Sulphate.

See Table X.

Coreco Argentine Ant Poison.

(COFFIN-REDINGTON CO., SAN FRANCISCO, CAL.)

	Guaranteed.	Found.
Arsenic, metal	0.15	0.21

Cal. Dept. Agr., Spec. Pub. 75, 24 (1927).

Coro Natholeum Dip.

(WEST DISINFECTING CO., SAN FRANCISCO, CAL.)

Found: Phenols 9.00 per cent; water 11.20 per cent.

Cal. Dept. Agr., Spec. Pub. 51, 45 (1925).

Coro Noleum and C. N. Disinfectant.

(WEST DISINFECTING CO., SAN FRANCISCO, CAL.)

Found: Phenols 28.00 per cent; water 8.80 per cent.

Cal. Dept. Agr., Spec. Pub. 51, 44 (1925).

Cot Oil.

See "Oil Emulsions, Mineral".

Coulson's Poultry Spray.

See "Oil Emulsions, Mineral".

County Farm Bureau Mixture.

County Squirrel Poison (Barley).

See "Strcyhnine Preparations".

C. P. Lice and Mite Liquid.

See "Lime-Sulphur".

C. P. Lice and Mite Tablets.

(CHICKEN PHARMACY, PETALUMA, CAL.)

Found: Calcium sulphide 16.13 per cent; silica 7.38 per cent; iron and aluminum oxides 0.14 per cent; gypsum 6.47 per cent; sugar 57.80 per cent; starch 11.63 per cent.

Cal. Dept. Agr., Spec. Pub. 51, 11 (1925).

TABLE IX. COPPER CARBONATE

Manufacturer or Distributor and Brand	Copper, Cu.		Publication
	Guaranteed	Found	
	%	%	
Braun-Knecht-Heimann Co., San Francisco, Cal.	50.00	52.10	Ore. Agr. Expt. Sta., Cir. 12 (1927).
California Spray Chemical Co., Watsonville, Cal. Ortho	51.92	52.40	Cal. Dept. Agr., Spec. Pub. 19 (1925).
Miller Products Co., Portland, Ore.	53.00	55.50	Ore. Agr. Expt. Sta., Cir. 12 (1927).
Montgomery, Ward & Co., Portland, Ore.	54.00	54.00	Ore. Agr. Expt. Sta., Cir. 12 (1925).
The Mountain Copper Co., San Francisco, Cal.	54.00	54.10	Ore. Agr. Expt. Sta., Cir. 12 (1927).
Nichols Copper Co., New York, N.Y.	53.00	54.00	Ore. Agr. Expt. Sta., Cir. 12 (1927).
Pittsburgh Plate Glass Co., Newark, N. J. Corona Copper-carb Dry	18.00	20.09	Cal. Dept. Agr., Spec. Pub. 43 (1927).
Roessler & Hasslacher Chemical Co., New York, N. Y.	53.00	49.30	Ore. Agr. Expt. Sta., Cir. 12 (1925).
San Jose Spray Mfg. Co., San Jose, Cal.	.....	53.30[1]	Cal. Dept. Agr., Spec. Pub. 19 (1925).
Sherwin-Williams Co., Emeryville, Cal.	50.00	51.30	Ore. Agr. Expt. Sta., Cir. 12 (1925).
Wheeler, Reynolds & Stauffer, San Francisco, Cal. Stauffer's	50.00	50.13	Cal. Dept. Agr., Spec. Pub. 22 (1925).

[1] 99.90 per cent passes a 200 mesh sieve.

TABLE X. COPPER SULPHATE

Manufacturer or Distributor and Brand	Copper, Cu.		Copper Sulphate		Publication
	Guaranteed	Found	Guaranteed	Found	
	%	%	%	%	
California Spray Chemical Co., Watsonville, Cal. Ortho Instant Bluestone	23.00	24.41	....	....	Cal. Dept. Agr., Spec. Pub. 66, 20 (1926).
California Spray Chemical Co., Watsonville, Cal. Ortho Powdered Bluestone, Package B.	24.00	23.06	....	....	Cal. Dept. Agr., Spec. Pub. 58, 21 (1925).
Manufacturer unknown. Monohydrated Copper Sulphate[1]	....	....	....	....	Conn. Agr. Expt. Sta., Sample 6913 (1928).
Mountain Copper Co., San Francisco, Cal. Mococo Bluestone	....	25.30	99.00	99.38	Cal. Dept. Agr., Spec. Pub. 66, 20 (1926).
Nichols Copper Co., New York, N. Y.	....	....	25.20	24.90	Ore. Agr. Expt. Sta., Cir. 84, 15 (1927).

[1] 94 per cent passed a 300-mesh sieve.

Edward I. Creeley's Insect Powder.

(ARBURUA & MC INNES, SAN FRANCISCO, CAL.)

	Guaranteed.	Found.
Nicotine	0.002	0.04
Naphthalene	3.00	3.20
Sulphur	5.00	5.60
Phenols	1.00	0.40
Pyrethrum	6.00	....

Cal. Dept. Agr., Spec. Pub. 75, 40 (1927).

Creo Fenol Sheep Dip.

See "Phenol Soap Solutions".

Creolineum.

(H. S. FAWCETT, RIVERSIDE, CAL.)

Found: Light oils 17.10 per cent; medium oils 27.20 per cent; heavy oils 49.00 per cent; total oils 93.30 per cent; phenols 2.90 per cent; inert matter 3.80 per cent.

Cal. Dept. Agr., Spec. Pub. 34, 39 (1923).

Creosote.

See "Brininstool".

Creosote Oil.

(AN-FO MFG. CO., OAKLAND, CAL.)

	Guaranteed.	Found.
Phenols	25.00	26.70
Coal-tar oils	....	72.10
Water	10.00	1.20

Cal. Dept. Agr., Spec. Pub. 75, 56 (1927).

Cresol.

(WESTERN WHOLESALE DRUG CO., LOS ANGELES, CAL.)

Found: Phenols 45.30 per cent; water 21.80 per cent.

Cal. Dept. Agr., Spec. Pub. 51, 43 (1925).

Cresolite Sheep Dip.

See "Phenol Soap Solutions".

Crestall Dip.

(BAIRD & MC GUIRE, HOLBROOK, MASS.)

Found: Phenols 51.90 per cent; water 12.40 per cent.

Cal. Dept. Agr., Spec. Pub. 51, 43 (1925).

Cresylic Acid, Pure.

(PURITY CHEMICAL PRODUCTS CO., SANTA ROSA, CAL.)

	Guaranteed.	Found.
Phenols	98.00	96.85
Water	2.00	3.20

Cal. Dept. Agr., Spec. Pub. 75, 56 (1927).

Cresy-Lol.

See "Phenol Soap Solutions".

Crude Oil.

See "Oils, Mineral".

Crude Oil Emulsion.

See "Oil Emulsions, Mineral".

Cut Worm and Grub Destroyer.

(CARPENTER-UDELL CHEM. CO., GRAND RAPIDS, MICH.)

	Guaranteed.	Found.
Arsenic, metal	0.95	0.83

Mich. Agr. Coll. Expt. Sta., Spec. Bull. 75, 9 (1915).

Cyanide-Chloride Marl Dust Mixture.

(J. S. MUNROE, SAN JOSE, CAL.)

Found: Pounds per ton: sodium cyanide, 4.24; sodium chloride 4.7.
Cal. Dept. Agr., Spec. Pub. 34, 57 (1923).

D.

D. C. Dust No. 3

See "Niagara D. C. Dust No. 3".

Dead Shot Squirrel and Gopher Killer.

See "Strychnine Preparations".

Death Dust for Insects.

See "Pyrethrum".

D 18 Dust Mixture.

See "Niagara D 18 Dust Mixture".

De Lapp's Improved Lice Powder.

(W. C. DE LAPP).

	Guaranteed.	Found.
Nicotine	0.10	0.11
Naphthalene	3.00	1.02
Sulphur	15.00	12.40
Phenols	0.50	0.60
Hydrocarbons	7.00	4.20
Sodium Fluoride	7.00	3.44

Cal. Dept. Agr., Spec. Pub. 75, 40 (1927).

Del Monte Bleaching Fluid.

(DEL MONTE BLEACHING FLUID CO., SAN FRANCISCO, CAL.)

	Guaranteed.	Found.
Available chlorine	5.00	4.82

Cal. Dept. Agr., Spec. Pub. 75, 61 (1927).

Delousing Grease.

(PETALUMA AVIAN PATHOLOGY, LABORATORY, PETALUMA, CAL.)

	Guaranteed.	Found.
Sodium fluoride	50.00	55.93

Cal. Dept. Agr., Spec. Pub. 75, 62 (1927).

Dendrol.

See "Oils, Mineral".

Derrisol

(WILLIAM COOPER & NEPHEWS, INC., CHICAGO, ILL.)

Guaranteed: Derris extract 5 per cent; fatty acid 50 per cent; inert matter 45 per cent.

Found: Non-volatile chloroform extract 60.45 per cent; water 18 per cent; ash 8.08 per cent; combined fatty acids (calculated from alkalinity of soluble ash) 0.62 per cent. The fatty acids if present must be present in the free form and not as soap.

Conn. Agr. Expt. Sta., Sample 8931.

Derris Root.

(MANUFACTURER UNKNOWN)

Found: Moisture 6.48 per cent; ether extract 8.79 per cent; methoxyl content 14.90 per cent; alcohol extract after ether extraction 14.25 per cent; passing 20 mesh, 100 per cent; 40 mesh, 100 per cent; 60 mesh, 91 per cent; 80 mesh, 79 per cent; 100 mesh, 72 per cent.

Canada Dept. Agr., Div. Chem., Rept., Dominion Chemist (1928).

Destroyer, Argentine Ant Syrup.

(TOWNE-ALLISON DRUG CO., SAN BERNARDINO, CAL.)

Found: Arsenious oxide 0.11 per cent; total arsenic, metal 0.083 per cent; invert sugar 32.10 per cent; cane sugar 20.86 per cent; water 47.25 per cent.

Cal. Dept. Agr., Spec. Pub. 58, 17 (1925).

Destruxol.

(PARAGON CHEMICAL CO.)

	Guaranteed.	Found.
Nicotine	12.00	18.54
Sodium cyanide	8.00	15.67
Carbolic acid	2.00	2.39
Wood creosote oils	20.00	17.27
Water	....	27.36

Cal. Dept. Agr., Spec. Pub. 75, 42 (1927).

Dethol Fly Spray.

(DETHOL MFG. CO., RICHMOND, VA.)

Not analyzed.

Cal. Dept. Agr., Spec. Pub. 58, 48 (1925).

Di-Fli Home Spray.

See "Oils, Mineral".

Dr. Baker's Liquid Death Drops.

(JAMES AINSLIE, BROOKLYN, N.Y.)

Found: The substance is gasoline.

U. S. D. A., Bur. Chem., Bull. 68, 57 (1902).

Dipdust.

See "Bayer Dipdust".

Dips.

See "Phenol Soap Solutions".

Dr. David Robert's Poultry Louse Powder.

(DR. DAVID ROBERTS VETERINARY CO., INC.)

	Guaranteed.	Found.
Nicotine	0.04	0.28
Naphthalene	9.00	9.98
Sulphur	18.00	19.80
Sodium fluoride	5.00	0.54

Cal. Dept. Agr. Spec. Pub. 75, 40 (1927).

Dr. G. Z. Wait's Sheep Dip.

Dr. Hess Dip & Disinfectant.

Dr. Le Gear's Dip & Disinfectant.

See "Phenol Soap Solutions".

Dr. Pierce's Bug Killer.

(THE KELLEY ISLAND LIME & TRANSPORT CO., CLEVELAND, OHIO.)

	Guaranteed.	Found.
Total arsenic (metallic)	0.56	1.33
Water-soluble arsenic (metallic)	0.03	0.30
Copper	....	0.53

N. J. Agr. Expt. Sta., Bull. 286, 13 (1915).

Dormant Dust.

(NIAGARA SPRAYER CO., SAN FRANCISCO, CAL.)

	Guaranteed.	Found.
Sodium polysulphide	40.00	22.3

Ore. Agr. Expt. Sta., Cir. 84, 11 (1927).

Dormant Soluble Oil.

See "Oil Emulsions, Mineral".

Dosch B-12 Green Copper Arsenic Dust.

(DOSCH CHEMICAL CO., LOUISVILLE, KY.)

	Guaranteed.	Found.
Copper	5.75	5.79
Arsenic, metal	2.75	3.39

The arsenic is present as calcium arsenate.

Conn. Agr. Expt., Sta., Bull. 258, 370 (1924).

Dosch 85-15 Sulfur-Lead Arsenate.

(DOSCH CHEMICAL CO., LOUISVILLE, KY.)

Found: Moisture 0.50 per cent; free sulphur none; lead oxide 8.60 per cent; arsenic oxide 4.80 per cent; silica 0.50 per cent; sodium sulphate 2.33 per cent; calcium carbonate 0.23 per cent; calcium hydroxide 79.52 per cent; magnesium carbonate 2.41 per cent; iron and aluminum oxides, none.

Cal. Dept. Agr., Spec. Pub. 34, 56 (1923).

Dosch Nicotine-Sulfur Dust.

See "Nicotine-Sulphur Dusts".

Dosch No. 6 Nicotine Dust.

Dosch No. 10 Nico-Dust.

See "Nicotine Dusts".

Dosch Sulfur-Arsenate Dust.

(DOSCH CHEMICAL CO., LOUISVILLE, KY.)

	Guaranteed.	Found.
Sulphur	84.00	84.00
Lead Arsenate	14.70	14.80

Cal. Dept. Agr., Spec. Pub. 34, 56 (1923).

Dosch Tobacco Dust.

See "Tobacco Dusts".

Double Nico-Dust.

Double Nicotine Dust.

See "Nicotine Dusts".

Dry Mix Sulfur-Lime.

(MECHLING BROS. CHEMICAL CO., CAMDEN, N. J.)

See also "New Jersey Dry Mix Sulfur-Lime", and "Niagara Dry Mix."

	Guaranteed.	Found.
Sulphur	62.00	62.80

N. J. Agr. Expt. Sta., Bull. 424, 10 (1925).

D 6 Dust.

See "Niagara D 6 Dust".

D 20 Dust.

See "Niagara D 20 Dust".

D 25 Potato Dust.

See "Niagara D 25 Potato Dust".

Du Pont Semesan, Jr.

(E. J. DU PONT DE NEMOURS & CO., INC., WILMINGTON, DEL.)

Guaranteed: Hydroxymercurichlorphenol 10.00 per cent.
Found: Mercury 6.59 per cent.
Cal. Dept. Agr. Spec. Pub. 75, 62 (1927).

Dustall No. 3.

Dustall No. 6.

Dustall No. 8.

Dustall No. 10.

See "Nicotine Dusts".

Dust Mixture No. 3, Niagara.

See "Nicotine Dusts".

Dust Mixture with Sulphur and Nicotine, Niagara.

See "Nicotine-Sulphur Dusts".

Dyke's Louse Paint.

(RAYMOND & CO., LAWRENCE, KANSAS)

Found: Petroleum, coal-tar, and carbon in suspension.
U. S. D. A., Bur. Chem., Bull. 68, 58 (1902).

E.

Earwig Bait.

(CITY OF PORTLAND, PORTLAND, ORE.)

	Guaranteed.	Found.
Sodium fluoride	4.3	4.9

Ore. Agr. Expt. Sta., Cir. 64, 14 (1925).

Earwig Bait.

(HARDY MFG. CO., PORTLAND, ORE.)

	Guaranteed.	Found.
Sodium fluoride	4.3	4.8

Ore. Agr. Expt. Sta., Cir. 84, 15 (1927).

Earwig Bait.

(MILLER PRODUCTS CO., PORTLAND, ORE.)

	Guaranteed.	Found.
Sodium fluoride	4.3	4.7

Ore. Agr. Expt., Sta., Cir. 64, 14 (1925).

Economy Germicide Dip.

See "Phenol Soap Solutions".

85-15 Dusting Mixture.

80-10-10 Mixture.

See "Nicotine Dusts".

80 Sulphur-20 Lime.

(MECHLING BROS. CHEMICAL CO., CAMDEN, N. J.)

	Guaranteed.	Found.
Sulphur	79.00	77.99

N. J. Agr. Expt. Sta., Bull. 441, 7 (1926).

80-20.

(J. R. GILLAM & BRO., BURLINGTON, N. J.)

	Guaranteed.	Found.
Sulphur	78.00	74.60

N. J. Agr. Expt. Sta., Bull. 441, 7 (1926).

80-20 Mixture.

See "Niagara 80-20 Mixture".

80-20 Sulphur-Lime Dust.

(LUCAS KIL-TONE CO., VINELAND, N. J.)

Guaranteed: Sulphur 80.00 per cent.

Found: Sulphur 76.49 per cent. Fineness: coarser than 100 mesh, 0.80; passes 100 mesh, 99.2; 200 mesh, 77.1; 300 mesh, 24.60.

N. J. Agr. Expt. Sta., Bull. 459, 8 (1927).

80-20 Sulfur-Lime Mixture.

(LUCAS KIL-TONE CO., VINELAND, N. J.)

Guaranteed: Sulphur 80.00 per cent.

Found: Sulphur 77.84 per cent. Fineness: passes 100 mesh, 55.50; 200 mesh, 37.80; 300 mesh, 6.70.

N. J. Agr. Expt. Sta., Bull. 459,8 (1927).

Electric Rat & Roach Paste.

See "Phosphorus Preparations".

Electric Vermin Exterminator.

(F. B. SMITH, CANTON, OHIO.)

Found: Sand 0.69 per cent; carbon dioxide 5.22 per cent; phenol anhydride 2.25 per cent; calcium oxide 58.28 per cent; magnesium oxide 12.77 per cent; water and pink dye, by difference, 20.79 per cent. Material is partially air-slaked lime treated with crude phenol and dyed pink.

U. S. D. A., Bur. Chem., Bull. 68, 51 (1902).

Electro Micro.

(VREELAND CHEMICAL MFG. CO., LITTLE FALLS, N. J.)

	Guaranteed.	Found.
Total arsenic, metal	9.25	10.73
Water-soluble arsenic, metal	0.50	0.08
Sulphur	48.00	46.21

N. J. Agr. Expt. Sta., Bull. 459, 16 (1927).

Electro Micro ½ and ½.

(VREELAND CHEMICAL CO., LITTLE FALLS, N. J.)

	Guaranteed.	Found.
Total arsenic oxide	12.60	14.36
Water-soluble arsenic oxide	0.77	0.57
Lead oxide	....	29.49
Sulphur	32.00	39.71

N. J. Agr. Expt. Sta., Bull. 301, 16 (1916).

Elkay's Rat and Roach Paste.

See "Phosphorus Preparations".

El Roy Argentine Ant Poison.

(ROY SPECIALTY CO.)

	Guaranteed.	Found.
Arsenic, metal	0.20	0.11

Cal. Dept. Agr., Spec. Pub. 75, 24 (1927).

El Roy Gopher Poison.

See "Strychnine Preparations".

El Vampiro.

(ALLAIRE, WOODWARD & CO.)

Guaranteed: Pyrethrum 75.00 per cent.

Found: Ash 6.98 per cent; organic matter 93.02 per cent.

Cal. Dept. Agr., Spec. Pub. 75, 63 (1927).

E. M. F. Orchard Spray.

Emulso.

See "Oil Emulsions, Mineral".

Entodust.

See "Arsenate of Lead".

Entomocide.

(SACRAMENTO CHEM. CO., SACRAMENTO, CAL.)

Claimed to contain phenol, carbon tetrachloride, oil of citronella and mineral oil.

Ore. Agr. Expt. Sta., Cir. 64, 15 (1925).

Estes's Roach Powder.

(N. T. ESTES & CO., OMAHA, NEB.)

Found: Borax 93.31 per cent; balance is pink coloring matter.

U. S. D., A. Bur. Chem., Bull. 68, 43 (1902).

Exelol.

See "Oil Emulsions, Mineral".

Extermo.

(L. T. GRAVES FERTILIZER CO., PASADENA, CAL.)

Claimed to be both a fertilizer and an insecticide.

Found: Nitrogen 0.18 per cent; phosphoric acid 0.06 per cent; potassium oxide 0.08 per cent; organic matter 62.19 per cent; mineral matter 32.21 per cent; sodium carbonate 4.66 per cent; soap 1.10 per cent; moisture 5.60 per cent.

Cal. Dept. Agr., Spec. Pub. 34, 60 (1923).

E-Z Burgundy.

See "Bordeaux Mixture".

E-Z Spray.

(E-Z WAY CO., OAKLAND, CAL.)

	Guaranteed.	Found.
Sodium polysulphide	33.00	33.62
Sodium thiosulphate	3.00	6.97
Soap	5.00	8.08

Cal. Dept. Agr., Spec. Pub. 58, 34 (1925).

F.

Fancier's Friend.

(JAMES BLANCHARD, NEW YORK, N.Y.)

Found: Moisture 5.03 per cent; ash 7.21 per cent; sulphur 30.77 per cent. Colored with lead chromate. Apparently intended as an imitation of pyrethrum.

U. S. D. A., Bur. Chem., Bull. 68, 53 (1902).

Felbro Whale Oil Soap.

See "Soaps".

Fertilizer and Insect Exterminator.

(MANUFACTURER NOT STATED).

Found: Moisture 7.60 per cent; organic matter 53.60 per cent; ash 39.80 per cent; sodium carbonate 5.30 per cent; nitrogen 0.69 per cent; phosphoric acid none; potassium trace. Probably a mixture of straw and sawdust, limestone, charcoal and ashes.

Cal. Dept. Agr., Spec. Pub. 34, 60 (1923).

Fertilore Soil Stimulant.

(FERTILORE CO., LOS ANGELES, CAL.)

WATER-SOLUBLE	Guaranteed.	Found.
Ferric oxide	23.98	19.25
Aluminum oxide	0.52	0.75
Copper oxide	0.40	1.25
Sulphur trioxide	39.75	25.80
WATER-INSOLUBLE		
Acid-insoluble	8.95	30.15
Ferric oxide	7.64	21.65
Aluminum oxide	0.11	0.50
Sulphur trioxide	6.72	45.93

CALCULATED COMPOSITION

Ferric sulphate	36.64
Copper sulphate	3.92
Aluminum sulphate	5.02
Iron Pyrites	3.50
Silica	9.25

Cal. Dept. Agr., Spec. Pub. 51, 58 (1925).

Fibro-Ferro Feeder.

(FIBRO-FERRO-FEEDER CO., GLENROSE, OHIO.)

Found: Moisture 7.80 per cent; sand 5.56 per cent; sulphur trioxide 22.37 per cent; chloride 7.70 per cent; ferric oxide 16.06 per cent; ferrous oxide 8.06 per cent. The substance is a mixture of organic matter (wood fibers) and partially oxidized ferrous chloride and sulphate.

U. S. D. A., Bur. Chem., Bull. 68, 52 (1902).

Fidelity Cockroach Paste.

See "Phosphorus Preparations".

50-50.

(NIAGARA SPRAYER CO., MIDDLEPORT, N. Y.)

	Guaranteed.	Found.
Lead arsenate	48.00	48.10

Ore. Agr. Expt. Sta., Cir. 64, 11 (1925).

Fir-Tree Oil Soap.

Fish Oil.

See "Oil, Fish".

Fish Oil Soap.

See "Soaps".

5 X.

See "Nicotine-Sulphur Dusts".

Flea-Off-Flea Powder.

(OSGOOD DRUG STORES, OAKLAND, CAL.)

Not analyzed.

Cal. Dept. Agr., Spec. Pub. 58, 48 (1925).

Fleck's Lice Exterminator.

(J. J. FLECK, TIFFIN, OHIO.)

Found: Insoluble in hydrochloric acid 4.20 per cent; carbon dioxide 9.56 per cent; sulphur trioxide 1.99 per cent; ferric oxide 1.43 per cent; calcium oxide 31.90 per cent; magnesium oxide 21.61 per cent; volatile matter other than carbon dioxide 29.88 per cent. The substance is a mixture of naphthalene, tobacco, partially air-slaked lime and pink dye.

U. S. D. A., Bur. Chem., Bull. 68, 54 (1902).

Fli-Mo-Cide.

See "Oils, Mineral".

Flit.

(THE STANDARD OIL CO., BAYONNE, N. J.)

Found: Specific gravity, 19° C., 0.810; flash point 60° C.; fire point 69° C.; residue at 100° C., 0.28 per cent; methyl salicylate 0.75 per cent. The base is kerosene.

Canada Dept. Agr., Div. Chem., Rept. Dominion Chemist (1928).

Floraferro.

(CALIFORNIA COPPER PRODUCERS TRUST.)

	Guaranteed	Found.
Ferrous sulphate	25.00	29.74
Ferric sulphate	20.00	24.34
Copper sulphate	5.00	5.61

Cal. Dept. Agr., Spec. Pub. 75, 45 (1927).

Floral Nicotine.

See "Nicotine Sulphate Solutions".

Fluoricide.[1]

(NITRATE AGENCIES, BAYONNE, N. J.)

	Guaranteed.	Found.	Guaranteed.	Found.
Fluorine	15.00	15.31	7.00	7.88

Conn. Agr. Expt. Sta., Samples 7506 and 7507.

Fly Croke.

See "Oils, Mineral".

Fly Foil.

Not analyzed.

Cal. Dept. Agr., Spec. Pub. 58, 48 (1925).

Fly-Tox.

(CANADA REX SPRAY CO., BRIGHTON, ONT., CANADA)

(See also "Rex Fly Tox").

Found: Specific gravity, 19°C., 0.830; flash point 66° C.; fire point 78° C.; residue at 100° C., 0.31 per cent; methyl salicylate 3.13 per cent; pyrethrum present. Base is kerosene.

Canada Dept. Agr., Div. Chem. Rept. Dominion Chemist (1928).

Fly X.

See "Sapho Fly X".

[1] Two grades.

Ford's Ant Powder.

(FORD CHEMICAL CO., OAKLAND, CAL.)

	Guaranteed.	Found.
Insect powder	7.00	....
Sodium fluoride	76.00	76.30
Organic matter	....	10.29

Cal. Dept. Agr., Spec. Pub. 75, 63 (1927).

Formaldehyde (Formalin).

TABLE XI. FORMALDEHYDE

Manufacturer or Distributor and Brand	Formaldehyde		Publication
	Guaranteed	Found	
	%	%	
Braun-Knecht-Heimann Co	37.00	36.80	Cal. Dept. Agr., Spec. Pub. 54 (1925).
Minneapolis Drug Co	.....	36.21	North Dakota Bull. 17, (1927).
Noyes Bros. & Cutler	.....	37.22	North Dakota Bull. 17, (1927).
Perth Amboy Chem. Wks., P.A.C.	37.00	36.82	Cal. Dept. Agr., Spec. Pub. 50 (1925).
Perth Amboy Chem. Wks., U. S. P. Solution	37.30	35.60	Cal. Dept. Agr., Spec. Pub. 54 (1925).
Roessler & Hasslacher Chem. Co., New York, N. Y.	37.00	37.70	Ore. Agr. Expt. Sta., Cir. 14 (1927).
Western Wholesale Drug Co., Los Angeles, Cal., U. S. P. Solution	37.30	37.28	Cal. Dept. Agr., Spec. Pub. 54 (1925).

"40" Dust.

(VAYCIDE CHEMICAL CORP., BINGHAMTON, ALA.)

	Guaranteed.	Found.
Total arsenic, metal	1.80	2.33
Water-soluble arsenic, metal	0.75	0.37
Copper	1.05	0.55
Sulphur	25.00	22.73
Nicotine	1.00	0.34

N. J. Agr. Expt. Sta., Bull. 424, 16 (1925).

40% Nicotine Sulphate.

See "Nicotine Sulphate Solutions".

Four and One Spray.

No. 14 Spray Oil.

See "Oils, Mineral."

Frazier's 5X.

See "Nicotine-Sulphur Dusts."

Frazier's Wet-O-Dry Sulphur.

(F. A. FRAZIER CO.)

	Guaranteed.	Found.
Sodium polysulphide	21.00	18.71
Sodium thiosulphate	12.00	13.15
Free sulphur	60.00	61.43

Cal. Dept. Agr., Spec. Pub. 58, 34 (1925).

Frazier's XX Sulphur.

(F. A. FRAZIER CO.)

	Guaranteed.	Found.
Sodium polysulphide	21.00	15.84
Sodium thiosulphate	12.00	10.09
Free sulphur	60.00	69.36
Inert matter	7.00	....

Cal. Dept. Agr., Spec. Pub. 51, 29 (1925).

Free Mulsion.

See "Oil Emulsions, Mineral".

Fresno.

(SCHOONMAKER & SONS, CEDAR HILL, N.Y.)

Found: This is an ammoniacal solution of copper carbonate containing 2.69 per cent. cupric oxide.

N. Y. Agr. Expt. Sta., Bull. 348, 98 (1912).

Fuller's Carbolic Insecticide Sheep Dip.

Fuller's Sheep Dip and Cattle Wash.

See "Phenol Soap Solutions".

Fumigator.

See "Nicotine Dusts."

Fumispray.

See "Oil Emulsions, Mineral".

Fungi-Bordo.

See "Bordeaux Mixture".

Fungine.

(APHINE MFG. CO., MADISON, N. J..

Found: Soluble sulphur 4.95 per cent.

N. Y. Agr. Expt. Sta., Bull. 384, 296 (1914).

Fungtrogen.

(CHEMICAL PRODUCTS DIVISION, ROSE MFG. CO., PHILADELPHIA, PA.)

	Guaranteed.	Found.
Copper	0.47	0.43
Nickel	0.47	0.32
Inert matter	99.06	....

Conn. Agr. Expt. Sta., Sample 9307.

Fungtrogen.

(GERMAIN SEED & PLANT CO., LOS ANGELES, CAL.)

	Guaranteed.	Found.
Copper	10.00	0.86

Cal. Dept. Agr., Spec. Pub. 75, 43 (1927).

G.

Garden Dust.

(DOSCH CHEMICAL CO., LOUISVILLE, KY.)

	Guaranteed.	Found.
Nicotine	2.00	2.24

A mixture of lead arsenate, sulphur and nicotine.

Conn. Agr. Expt. Sta., Bull. 242, 154 (1922).

Garden Guard.

See "Acme Garden Guard".

Garden Insecticide.

(GEO. H. LEE, OMAHA, NEB.)

Guaranteed: Nicotine, sodium fluoride, sulphur, naphthalene and pyrethrum present.

Found: There is a small deficiency in the sodium fluoride and sulphur.

Ore. Agr. Expt. Sta., Cir. 64, 15 (1925).

Germain Crude Carbolic Acid.

See "Phenol."

Germain Fish Oil Soap.

Germain's Rosin Wash.

See "Soaps".

Germain's Soluble Sulfur Compound.

(GERMAIN SEED & PLANT CO., LOS ANGELES, CAL.)

	Guaranteed.	Found.
Water-soluble	....	95.85
Polysulphide sulphur	....	37.22
Thiosulphate sulphur	....	13.57
Sulphate and sulphite sulphur	....	0.66
Total sulphur	....	51.45
Sodium polysulphide	56.00	48.95
Sodium thiosulphate	25.00	33.50
Free sulphur	4.00	4.00
Inert matter	15.00	....

Cal. Dept. Agr., Spec. Pub. 34, 32 (1923).

Germo.

See "Oils, Mineral."

Germo Carboline.

See "Phenol Soap Solutions."

Germo Cresolis.

(GERMO MFG. CO., LOS ANGELES, CAL.)

Found: Phenols 56.25 per cent; water 10.00 per cent.

Cal. Dept. Agr., Spec. Pub. 51, 43 (1925).

Germo Cresosote Dip.

See "Phenol Soap Solutions".

Germo Magic Lice Powder.

(GERMO MFG. CO., LOS ANGELES, CAL.)

	Guaranteed.	Found.
Nicotine	0.40	0.42
Naphthalene	10.00	11.12
Sulphur	20.00	14.16
Phenols	1.83	1.22

Cal. Dept. Agr. Spec. Pub. 75, 40 (1927).

Germo Rat Death.

(GERMO MFG. CO., LOS ANGELES, CAL.)

	Guaranteed.	Found.
Barium carbonate	96.50	98.50

Cal. Dept. Agr., Spec. Pub. 66, 34 (1926).

Germosol Special Disinfectant.

Germo Sheep Dip.

See "Phenol Soap Solutions."

Germo Worm Powder.

(GERMO MFG. CO., LOS ANGELES, CAL.)

Found: Volatile and organic matter 64.50 per cent; insoluble matter 2.35 per cent; calcium oxide 7.07 per cent; sulphur trioxide 10.81 per cent; ferric oxide 15.30 per cent.

Cal. Dept. Agr., Spec. Pub. 75, 65 (1927).

Getsem Gopher Exterminator.

(RICHERT AND ROYER.)

	Guaranteed.	Found.
Phenols	....	4.40
Water	1.00	trace

Cal. Dept. Agr., Spec. Pub. 75, 56 (1927).

Go-For Gopher.

See "Strychnine Preparations."

Gold Crown Poison.

Gold Crown Poison Barley.

See "Phosphorus Preparations."

Gopher Death.

Gopher-Get-er.

Gopher-Go.

Gopher-Scent.

See "Strychnine Preparations."

Government Formula Argentine Ant Poison.

(F. A. GARDNER & CO., RIVERSIDE, CAL.)

	Guaranteed.	Found.
Arsenious oxide	....	0.17
Total arsenic, metal	0.20	0.13

Cal. Dept. Agr., Spec. Pub. 66, 19 (1926).

Go-West

(M. J. FORSELL & CO., SEATTLE, WASH.)

	Guaranteed.	Found.
Calcium arsenate	5.00	5.40

Ore. Agr. Expt. Sta., Cir. 84, 15 (1927).

Grape Dust.

See "Hammond's Grape Dust."

Grasshopper Poison.

(EXCHANGE ORANGE PRODUCTS CO., LOS ANGELES, CAL.)

	Guaranteed.	Found.
Arsenious oxide	16.66	16.63
Arsenic, metal	12.00	12.58

(All water-soluble).

Cal. Dept. Agr., Spec. Pub. 34, 21 (1923).

Grasshopper Poison.

(SMITH-FRANK PACKING CO., SACRAMENTO, CAL.)

	Guaranteed.	Found.
Arsenious oxide	10.00	14.41
Arsenic metal	7.50	10.91

(All water-soluble).

Cal. Dept. Agr., Spec. Pub. 34, 21 (1923).

Gray Arsenoid (Calcium and Copper Arsenite).

(ADLER COLOR & CHEMICAL WORKS, NEW YORK, N.Y.

Found: Water 16.10 per cent; combined arsenious oxide 21.24 per cent. soluble arsenious oxide 13.76 per cent; cupric oxide 15.10 per cent; calcium oxide 27.10 per cent; carbon dioxide, Prussian blue, sodium sulphate, etc., 6.70 per cent.

Univ. of Calif., Coll. of Agr., Expt. Sta., Bull. 151, 25 (1903).

Graylawn Farm Louse Chase.

(GRAYLAWN FARMS, INC., NEWPORT, VT.)

Guaranteed: Asagrea officinalis 10 per cent; sulphur 30 per cent; nicotine not less than 0.5 per cent; inert matter 59.50 per cent.

Found: Sulphur 32.21 per cent; nicotine 0.03 per cent; non-volatile alkaloids 1.88 per cent. Sabadilla alkaloids present. Inert matter mostly calcium hydroxide.

Conn. Agr. Expt. Sta., Sample 3432.

Green Arsenoid (Copper Arsenite).

(ADLER COLOR & CHEMICAL WORKS, NEW YORK, N.Y.)

Found: Cupric oxide 28.83 per cent; combined arsenious oxide 53.51 per cent; free arsenious oxide 7.82 per cent; moisture 2.77 per cent; silica 0.40 per cent; organic matter, sodium sulphate, etc. 6.67 per cent. Is dyed with "soluble blue".

Univ. of Calif., Coll. of Agr., Expt. Sta., Bull. 151, 26 (1903).

Green Cross Beetle Mort.

(LUCAS-KIL-TONE CO., VINELAND, N. J.)

	Guaranteed.	Found.
Total arsenic, metal	18.00	18.53
Water-soluble arsenic, metal	1.00	0.12
Copper	5.00	5.90

N. J. Agr. Expt. Sta., Bull. 459, 12 (1927).

Green Cross Copper Lime Dust.

(LUCAS-KIL-TONE CO., VINELAND, N. J.)

Found: Copper 10.99 per cent.

N. J. Agr. Expt. Sta., Bull. 459, 11 (1927).

Green Cross Nico-Tone.

(LUCAS-KIL-TONE CO., VINELAND, N. J.)

	Guaranteed.	Found.
Nicotine	2.75	2.86

N. J. Agr. Expt. Sta., Bull. 459, 7 (1927).

Green Cross P. B. K.

(LUCAS-KIL-TONE CO., VINELAND, N. J.)

	Guaranteed.	Found.
Total arsenic, metal	21.00	20.23
Water-soluble arsenic, metal	1.00	0.16
Copper	6.00	11.72

N. J. Agr. Expt. Sta., Bull. 459, 12 (1927).

Green Cross Sulpho-Arsenate Powder.

(THE KIL-TONE CO., NEWARK, N. J.)

	Guaranteed.	Found.
Total arsenic, metal	10.10	15.39
Water-soluble arsenic, metal	0.66	0.71
Lead oxide	....	33.17
Sulphur	48.00	49.20

N. J. Agr. Expt. Sta., Bull. 301, 14 (1916).

Green Death.

(FARMERS' INDUSTRIAL UNION, SYRACUSE, N. Y.)

Found: The substance is artificially colored calcium arsenite, containing 35.94 per cent arsenious oxide.

N. Y. Agr. Expt. Sta., Bull. 348, 98 (1912).

Green Label Hydroxide Paste.

See "Mechling."

Gregory's Special Ant Syrup.

(GREGORY INSECTICIDE CO., BERKELEY, CAL.)

Guaranteed: Arsenic 2.56 per cent.

Found: Arsenious oxide 1.01 per cent; arsenic metal 0.77 per cent; cane sugar 18.45 per cent; water 77.72 per cent.

Cal. Dept. Agr., Spec. Pub. 58, 16 (1925).

Gregory's Standard Ant Destroyer.

(GREGORY INSECTICIDE CO., BERKELEY, CAL.)

	Guaranteed.	Found.
Invert sugar	2.00	1.57
Cane sugar	38.00	20.78
Water	56.00	76.21
Tartar emetic	....	1.74

Cal. Dept. Agr., Spec. Pub. 58, 18 (1925).

Grub and Canker Worm Exterminator.

(G. H. MORRILL & CO., BOSTON, MASS.)

Found: Linseed oil 87.28 per cent; carbon 11.40 per cent; Prussian blue 1.32 per cent. This substance is printers' ink.

U. S. D. A., Bur. Chem., Bull. 68, 54 (1902).

H.

Hall's Lightning Squirrel and Gopher Poison.

See "Strychnine Preparations".

Hall's Nicotine Sulphate Solution.

See "Nicotine Sulphate Solutions."

Hammond's Copper Solution.

(HAMMOND'S SLUG SHOT WORKS, BEACON, N.Y.)

	Guaranteed.	Found.
Copper	3.05	3.70

N. J. Agr., Expt. Sta., Bull. 441, 11 (1926).

Hammond's Grape Dust.

(HAMMOND'S PAINT & SLUG SHOT WORKS, BEACON, N. Y.)

	Guaranteed.	Found.
Sulphur	64.00	63.87
Cupric oxide	0.7969	0.87
Nicotine	trace	present
Passing 100 mesh sieve	....	98.00
Passing 200 mesh sieve	....	88.00

Cal. Dept. Agr., Spec. Pub. 58, 50 (1925).

Handy Killer.

(RALPH B. ADAMS, LAKEVILLE, N. B., CANADA).

Found: Arsenious oxide 40.67 per cent. A strongly alkaline solution of sodium arsenite with a slight residue of iron oxide.

Canada Dept., Agr., Div. Chem., Rept. Dominion Chemist (1928).

He-Bo.

(STERLING CHEMICAL CO., CAMBRIDGE, MASS.)

	Guaranteed.	Found.
Barium carbonate	36.00	34.41
Total arsenic, metal	2.00	1.35
Water-soluble arsenic, metal	0.30	0.12

Conn. Agr., Expt. Sta., Bull. 242, 159 (1922).

Heine's Liquid Insect Destroyer and Disinfectant.

(HEINE CHEMICAL CO., HOLLIS, L. I.)

Found: The substance is a mixture of turpentine and kerosene.

U. S. D. A., Bur. Chem., Bull. 68, 57 (1902).

TABLE XII. HELLEBORE

Manufacturer or Distributor and Brand	Total Ash	Acid-Insoluble Ash	Alkaloids		Nitrogen	Publication
			Guaranteed	Found		
	%	%	%	%	%	
J. L. Hopkins & Co., New York, N. Y. White Hellebore Root	11.83	6.97	0.79	1.07	1.21	Conn. Agr. Expt. Sta., Bull. 242, 156 (1922).
Interstate Chemical Co., Jersey City, N. J. Key	10.56	5.03	0.25	1.43	1.29	Conn. Agr. Expt. Sta., Bull. 242, 156 (1922).
Leggett & Bro., New York, N. Y. Anchor.	7.50	3.23	0.20	1.26	1.59	Conn. Agr. Expt. Sta., Bull. 242, 156 (1922).
Lehn & Fink, New York, N. Y.[1]	....	....	....	....	...	Ore. Agr. Expt. Sta., Cir. 64, 15 (1925).
S. B. Penick & Co., New York, N. Y. Hellebore Root	9.25	5.40	1.14	1.27	....	Conn. Agr. Expt. Sta., Bull. 242, 156 (1922).
S. B. Penick & Co., New York, N. Y. Hellebore Root	4.46	1.05	1.00	2.70	1.48	Conn. Agr. Expt. Sta., Bull. 242, 156 (1922).

[1] Guaranteed to contain the alkaloids of powdered hellebore. Not analyzed.

Herbicide.

(READE MFG. CO., JERSEY CITY, N. J.)

Found: Solids 31.09 per cent; arsenious oxide 24.30 per cent; sodium arsenite ($NaAsO_2$), 31.90 per cent. A green alkaline solution.

Conn. Agr. Expt. Sta., Bull. 258, 376 (1924).

Herbicide (Concentrate) Arsenic.

(STRAUSS-LASHER LABORATORIES, LOS ANGELES, CAL.)

Found: Baumé gravity 50.40 ; arsenious oxide none; arsenic oxide 43.99 per cent. The preparation is a solution of arsenic acid.

Cal. Dept. Agr., Spec. Pub. 51, 17 (1925).

Hercules Carbolic Acid.

See "Phenol."

Herold Poultry Worm Capsules.

	Guaranteed.	Found.
Nicotine	15.00	15.05

Cal. Dept. Agr., Spec. Pub. 75, 35 (1927).

Hexol.

(SANITARY SUPPLY CO., SAN FRANCISCO, CAL.)

Guaranteed: Water 20.00 per cent.

Found: Soap 14.20 per cent; oils 61.80 per cent; water 23.40 per cent. Probably a pine oil preparation.

Cal. Dept. Agr., Spec. Pub. 75, 59 (1927).

Hexpo.

See "Bordeaux Mixture-Lead Arsenate."

Hirschey's Ant Control.

(HIRSCHEY'S ANT CONTROL)

Found: Arsenic 0.04 per cent.

Cal. Dept. Agr., Spec. Pub. 75, 24 (1927).

Hirschey's P. D. Q. Argentine Ant Solution.

(HIRSCHEY'S ANT CONTROL).

	Guaranteed.	Found.
Arsenic, metal	0.05	0.04

Cal. Dept. Agr., Spec. Pub. 66, 19 (1926).

Hockwald's Carbolicide.

(HOCKWALD CHEMICAL CO., SAN FRANCISCO, CAL.)

	Guaranteed.	Found.
Water	1.00	0.05

Cal. Dept. Agr., Spec. Pub. 75, 66 (1927).

Hockwald's Creosote Oil.

(HOCKWALD CHEMICAL CO., SAN FRANCISCO, CAL.)

	Guaranteed.	Found.
Oil	58.00	....
Phenols	40.00	43.60
Water	2.00	3.00
Baumé gravity of oil	....	1.20
Unsulphonated oil	....	1.80

Cal. Dept. Agr., Spec. Pub. 58, 46 (1925).

Hockwald's Sheep Dip.

See "Phenol Soap Solutions".

Hooper's Fatal Food.

(O. HOOPER JADWIN, NEW YORK, N. Y.)

Found: Borax 92.44 per cent. The balance is corn meal and red coloring matter.

U. S. D. A., Bur. Chem., Bull. 68, 43 (1902).

Hydrated Lime.

See "Lime."

Hydro-Cy.

See "Hydrocyanic Acid."

TABLE XIII. HYDROCYANIC ACID

Manufacturer or Distributor and Brand	Hydrogen Cyanide		Publication
	Guaranteed	Found	
	%	%	
fornia Cyanide Co., Cudahy, Cal. alcyco Braun Gas	80.00	82.30	Cal. Dept. Agr., Spec. Pub. 58, 47 (1925).
ago & Woodhead, Whittier, Cal. ydro-Prussic Acid	96.98	96.80	Cal. Dept. Agr., Spec. Pub. 34, 24 (1923).
Fumigating Co., Aero	96.00	97.50	Cal. Dept. Agr., Spec. Pub. 66, 34 (1926).
Fumigating Corporation. Owl russic Acid	.....	97.60	Cal. Dept. Agr., Spec. Pub. 34, 24 (1923).
Pacific R & H Chemical Corp. ydro-Cy	96.00	97.27	Cal. Dept. Agr., Spec. Pub. 66, 34 (1926).
Pacific R & H Chemical Corp., acific R & H	96.98	97.19	Cal. Dept. Agr., Spec. Pub. 51, 20 (1925).

Hydro-Prussic Acid.

See "Hydrocyanic Acid."

Hydroxcide Paste.

(MECHLING BROS. MFG. CO., CAMDEN, N. J.)

	Guaranteed.	Found.
Total arsenic, metal	6.50	4.90
Water-soluble arsenic, metal	0.75	0.07
Copper	5.00	4.89
Water	....	64.84

N. J. Agr. Expt. Sta., Bull. 407, 14 (1924).

Hydroxcide Powder.

(MECHLING BROS. CHEMICAL CO., CAMDEN, N. J.)

	Guaranteed.	Found.
Total arsenic, metal	12.50	16.33
Water-soluble arsenic, metal	1.50	0.23
Copper	12.50	12.92

N. J. Agr. Expt., Sta., Bull. 459, 12 (1927).

I.

Impco Brand Nicotine Sulphur Dust.

See "Nicotine-Sulphur Dusts".

Impco Complete Garden Dust.

(INTERNATIONAL MILLING CO.)

	Guaranteed.	Found.
Nicotine	0.50	0.52
Sulphur	25.00	27.82
Arsenic oxide	....	4.11
Lead oxide	....	5.75
Passing 100 mesh	....	85.00
Passing 200 mesh	....	66.00

Cal. Dept. Agr., Spec. Pub. 58, 26 (1925).

Impco Extra Strong Insecticide Dust.

Impco Insecticide Dust.

Impco Poultry Tobacco Dust Worm Cure.

Impco Strong Insecticide Dust.

See "Nicotine Dusts."

Imperial Lice and Mite Remedy.

See "Lime-Sulphur."

Improved Kil-Tone.

(THE KIL-TONE CO., VINELAND, N. J.)

	Guaranteed.	Found.
Total arsenic, metal	5.80	7.48
Water-soluble arsenic, metal	0.50	0.19
Copper	2.45	2.14

N. J. Agr. Expt. Sta., Bull. 407, 13 (1924)

Individual Single Treatment for Round Worms.

(AN-FO MFG. CO., OAKLAND, CAL.)

	Guaranteed.	Found.
Nicotine	15.00	15.61

Cal. Dept. Agr., Spec. Pub. 75, 35 (1927).

Insecticide.

(A. ST. LEGER, LAGO MAGGIORE, ITALY.)

A dark-colored odoriferous liquid, strongly alkaline; a sulphonated tar oil neutralized with ammonia and apparently containing "Rotenone", the active principle of derris.

Canada Dept. Agr., Div. Chem., Rept. Dominion Chemist (1928).

Insectonos.

(WILLIAM BRANSON)

Found: Pyrethrum is the active ingredient. The inert ingredients are charcoal and essential oils.

Mich. Agr. Coll. Expt. Sta., Spec. Bull. 74, 10 (1915).

Insecto No. 1.

See "Oil Emulsions, Mineral".

Insect Powder.

See "Pyrethrum."

Insectrogen.

(CHEMICAL PRODUCTS DIVISION, ROSE MFG. CO., PHILADELPHIA, PA.)

	Guaranteed.	Found.
Total arsenic, metal	1.75	2.69
Water-soluble arsenic, metal	0.15	0.27
Lead arsenate ($PbHAsO_4$)	10.53	12 47
Nickel	0.47	0.44
Soap	13.05	10.89
Inert matter	73.95	....

Conn. Agr. Expt. Sta., Sample 9308.

Instant Louse Killer.

(DR. HESS & CO., ASHLAND, OHIO.)

Found: Moisture, 1.21 per cent; ash insoluble in hydrochloric acid, 27.10 per cent; ash soluble in hydrochloric acid, 64.78 per cent; carbon dioxide, coal-tar products and tobacco by difference, 6.91 per cent. Large amounts of iron, aluminum, calcium and carbonate, some magnesium, a little sulphate and phosphate. The substance consists of small amounts of calcium phenate and tobacco with large amounts of lime, calcium carbonate and clay.

U. S. D. A., Bur. Chem., Bull. 68, 51 (1902).

Iricide.

(GRING'S IRICIDE CO., BERKELEY, CAL.)

	Guaranteed.	Found.
Arsenic	0.10	0.15

Cal. Dept. Agr., Spec. Pub. 75, 24 (1927).

J.

Jebl.

(J. H. RICE, ASHTABULA, OHIO.)

Guaranteed: Nicotine 0.80 per cent; inert matter 99.20 per cent.

Found: Nicotine 1.08 per cent; water and volatile matter 79.29 per cent; solids 20.71 per cent; ash 7.85 per cent.

Conn. Agr. Expt. Sta., Bull. 242, 154 (1922).

Jenning's Soluble Pine Oil.

(SANITARY SUPPLY CO.)

	Guaranteed.	Found.
Soap	....	12.10
Water	....	34.80
Pine Oil	55.00	53.32

Cal. Dept. Agr., Spec. Pub. 75, 55 (1927).

J. & M. Reliable Insecticide.

See "Soaps".

K.

Kalibor.

(NITRATE AGENCIES CO., BAYONNE, N. J.)

	Guaranteed.	Found.
Total arsenic, metal	18.20	18.18
Water-soluble arsenic, metal	0.75	0.12
Copper	3.50	3.51

N. J. Agr. Expt. Sta., Bull. 459, 15 (1927).

Kamforite "H".

(HENEMAN BROS., HORNCASTLE, ENGLAND).

Claimed to be a combined pest destroyer, fumigant and fertilizer.

Found: Naphthalene 25.41 per cent; nitrogen 0.25 per cent; phosphoric anhydride 4.33 per cent; potassium none. Ground bone, soot, lime and iron.

Canada Dept. Agr., Div. Chem., Rept. Dominion Chemist (1928).

Karspray.

See "Phenol Soap Solutions".

Kasulime.

(NITRATE AGENCIES CO., BAYONNE, N. J.)

Guaranteed: Sulphur 60.00 per cent.

Found: Sulphur 49.82 per cent; coarser than 100 mesh, 2.15 per cent; passing 100 mesh sieve, 86.35 per cent; 200 mesh 10.25 per cent; 300 mesh 1.25 per cent.

N. J. Agr. Expt. Sta., Bull. 459, 8 (1927).

Keresol.

Kerosene Emulsion.

See "Oil Emulsions, Mineral".

Key Brand B. A. Cartridges.

(INTERSTATE CHEMICAL CO., JERSEY CITY, N. J.)

	Guaranteed.	Found.
Total arsenic, metal	4.50	6.39
Water-soluble arsenic, metal	0.75	0.68
Copper	9.00	10.14

N. J. Agr. Expt. Sta., Bull. 424, 13 (1925).

Key Brand B. Beetle Destroyer.

(INTERSTATE CHEMICAL CO., JERSEY CITY, N. J.)

	Guaranteed.	Found.
Total arsenic, metal	14.00	19.40
Water-soluble arsenic, metal	1.00	0.20
Copper	5.00	5.02

N. J. Agr. Expt. Sta., Bull. 459, 11 (1927).

Key Brand Key B.

(INTERSTATE CHEMICAL CO., JERSEY CITY, N. J.)

	Guaranteed.	Found.
Total arsenic, metal	14.00	18.90
Water-soluble arsenic, metal	1.00	1.21
Copper	5.00	4.93

N. J. Agr. Expt. Sta., Bull. 441, 12 (1926).

Key Brand No. 7 Key Green.

(INTERSTATE CHEMICAL CO., JERSEY CITY, N. J.)

	Guaranteed.	Found.
Total arsenic, metal	15.00	16.02
Water-soluble arsenic, metal	3.00	0.34
Copper	....	17.33

N. J. Agr. Expt. Sta., Bull. 441, 12 (1926).

Key-Cide.

See "Bordeaux Mixture-Lead Arsenate".

K-G Ant Poison.

(KIRK-GEARY CO., SACRAMENTO, CAL.)

Guaranteed: Arsenic 0.10 per cent.

Found: Arsenic 0.13 per cent; invert sugar 39.50 per cent; cane sugar 19.38 per cent; dextrin, etc., 4.22 per cent; water 35.01 per cent.

Cal. Dept. Agr., Spec. Pub. 58, 16 (1925).

Kill-A-Mite.

(GRANT-ERICSON CO., SAN DIEGO, CAL.)

Guaranteed: Carbolic acid a certain per cent, inert matter none.

Found: Oils 94.11 per cent; phenol 1.84 per cent free sulphur 2.17 per cent; water 1.40 per cent.

Cal. Dept. Agr., Spec. Pub. 51, 60 (1925).

Kill Hopper.

(GERMAIN SEED & PLANT CO., LOS ANGELES, CAL.)

	Guaranteed.	Found.
Arsenic	12.00	12.78

Cal. Dept. Agr., Spec. Pub. 75, 26 (1927).

Kill-Well Worm Expeller.

(CHICKEN PHARMACY, PETALUMA, CAL.)

	Guaranteed.	Found.
Water	54.00	76.60

Cal. Dept. Agr., Spec. Pub. 75, 64 (1927).

Kilmol Squirrel-zophene.

See "Carbon Disulphide."

Kilto.

See "Allen's Kilto Paste."

Kil-Tone, Improved.

See "Improved Kil-Tone."

Kil-Tone, Modified.

See "Bordeaux Mixture."

Kirk Geary Dipsol Sheep Dip.

See "Phenol Soap Solutions."

Kisants.

(BRUNSWIG DRUG CO., LOS ANGELES, CAL.)

	Guaranteed.	Found.
Arsenious oxide	11.00	7.78
Arsenic, metal	8.60	5.89

Cal. Dept. Agr., Spec. Pub. 58, 16 (1925).

Kleenup Oil.

See "Oils, Mineral."

Kloral.

(A. R. MAAS CHEMICAL CO.)

	Guaranteed.	Found.
Available chlorine	5.00	4.18

Cal. Dept. Agr., Spec. Pub. 75, 61 (1927).

K. M. G. Kills Morning Glory.

(WEED CONTROL CO. OF CALIFORNIA, BERKELEY, CAL.)

	Guaranteed.	Found.
Arsenic chloride ($AsCl_5$)	5.00	8.02
Arsenic acid (H_3AsO_4)	....	4.79

Cal. Dept. Agr., Spec. Pub. 66, 18 (1926).

Kolodust.

See "Sulphur".

Koloform.

Kolotax.

See "Nicotine Dusts."

Krelos.

See "Phenol Soap Solutions."

Krenol Dip.

See "Phenol Soap Solutions."

Kreo Phene.

(PURITY CHEMICAL PRODUCTS CO., SANTA ROSA, CAL.)

Guaranteed: Coal-tar oils 97.00 per cent.

Found: Phenols 41.40 per cent; coal-tar oils 57.60 per cent; moisture 1.00 per cent.

Cal. Dept. Agr. Spec. Pub. 75, 56 (1927).

Kreso Dip No. 1

See "Phenol Soap Solutions."

K. S. Q.

(HEMINGWAY & CO., INC., BOUND BROOK, N. J.)

	Guaranteed.	Found.
Total arsenic oxide	35.00	31.00
Water-soluble arsenic oxide	0.50	0.27
Cupric hydroxide [$Cu(OH)_2$]	....	14.16

N. J. Agr. Expt. Sta., Bull. 273, 11 (1914).

L.

Lambert's Death to Lice.

(D. J. LAMBERT, APPONAUG, R. I.)

Found: Moisture 3.97 per cent; ash insoluble in hydrochloric acid 35.91 per cent; ash soluble in hydrochloric acid 31.40 per cent; volatile matter other than moisture 28.72 per cent; a large amount of calcium, some iron, magnesium, potassium, sodium and carbonate, traces of sulphate and phosphate. The substance is a mixture of tobacco, lime, coal-tar products and dirt.

U. S. D. A., Bur. Chem., Bull. 68, 50 (1902).

Larvex.

(LARVEX CORP., BROOKLYN, N.Y.)

Guaranteed: Sodium aluminum silicofluoride 0.52 per cent; inert matter 99.48 per cent.

Found: Total solids 0.89 per cent; fluorine 0.41 per cent; silica 0.15 per cent; aluminum oxide 0.02 per cent; sodium and organic matter 0.40 per cent.

North Dakota, Bull. 17, 52 (1927).

Laurel Green.

(NICHOLS CHEMICAL CO., NEW YORK, N. Y.)

Found: Gypsum 50.00 per cent; greensand 20.20 per cent; copper arsenite 24.70 per cent; moisture, etc., 5.1 per cent; soluble arsenic compounds, 0.8 per cent.

Univ. of Cal., Coll. of Agr., Expt. Sta. Bull. 151, 24 (1903).

Lead Arsenate.

See "Arsenate of Lead."

Lead Arsenite.

See "Pink Arsenoid".

Lead Phenate.

(These are experimental preparations made by Dr. Friend of the Entomology Department of the Connecticut Agricultural Experiment Station.)

Sample No.	3351	7523	8257
Lead oxide	62.64	62.00	66.23
Phenol	31.61	38.82	33.25
Water	2.65	....	0.05

Sample **8257** corresponds approximately to the formula $6PbO.\ 7C_6H_5OH$

Lee's Insect Powder.

(G. H. LEE CO., OMAHA, NEB.)

Found: Sulphur 47.93 per cent; arsenious oxide 5.00 per cent. Remainder probably tobacco and pyrethrum.

U. S. D. A., Bur. Chem., Bull. 68, 31 (1902).

Lee's Lice Killer.

(G. H. LEE CO., OMAHA, NEB.)

Found: Sample is probably creosote oil.

U. S. D. A., Bur. Chem., Bull. 68, 55 (1902).

Lee's Louse Powder.

(GEO. H. LEE CO., OMAHA, NEB.)

	Guaranteed.	Found.
Naphthalene	2.00	0.60
Free sulphur	43.00	43.80
Pyrethrum	2.00	....
Sodium fluoride	3.00	3.01

Cal. Dept. Agr., Spec. Pub. 75, 40 (1927).

Leggett's Killer.

(LEGGETT & BRO., NEW YORK, N. Y.)

Found: The substance is oil of turpentine.

U. S. D. A., Bur. Chem., Bull. 68, 56 (1902).

Leggett's Roach Destroyer.

(LEGGETT & BRO., NEW YORK, N. Y.)

Found: Borax 22.22 per cent; pyrethrum and blue coloring matter present.

U. S. D. A., Bur. Chem., Bull. 68, 43 (1902).

Leinen's Mildew Go.

(BAY CITY SEED CO., SAN FRANCISCO, CAL.)

	Guaranteed.	Found
Free sulphur	75.00	73.34
Calcium hydroxide	25.00	23.84

Cal. Dept. Agr., Spec. Pub. 34, 57 (1923).

Leinen's Poisoned Barley.

See "Strychnine Preparations."

Leinen's Rat-Go.

(JOHN F. LEINEN CHEMICAL CO.)

Guaranteed: Active ingredients 97.50 per cent; barium sulphate 0.30 per cent; silica 0.40 per cent; water 1.80 per cent.

Found: Barium carbonate 98.33 per cent.

Cal. Dept. Agr., Spec. Pub. 75, 66 (1927).

Leinen's Sow-Bug Go.

(JOHN F. LEINEN CHEMICAL CO.)

	Guaranteed.	Found,
Total arsenic, metal	37.00	5.05
Water-soluble arsenic, metal	2.80	0.64

Cal. Dept. Agr., Spec. Pub. 75, 26 (1927).

Lemon Oil Company's Standard Insecticide.

(GERMAIN SEED & PLANT CO., LOS ANGELES, CAL.)

	Guaranteed.	Found.
Dry Soap	6.00	11.85
Potassium carbonate	0.50	1.11
Vegetable oil	3.50	7.45
Terebenthine	5.00	
Water	85.00	79.20

Cal. Dept. Agr. Spec. Pub. 75, 65 (1927).

Lennox Tobacco Soap.

See "Nicotine Soaps".

Lice-Go-Powder.

(S. O. BARNES & SON, GARDENA, CAL.)

Guaranteed: Talc 70.00 per cent.

Found: Naphthalene 3.71 per cent; sodium fluoride 3.30 per cent; essential oils present; loss at 400° C., 3.78 per cent; water 1.40 per cent; talc 11.16 per cent; calcium carbonate 70.10 per cent; calcium hydroxide 7.62 per cent; iron and aluminum oxides 1.10 per cent.

Cal. Dept. Agr., Spec. Pub. 51, 59 (1925).

Licresol.

Licresolis.

See "Phenol Soap Solutions."

Lilacko Spray

See "Oils, Mineral."

Lilly Pulvules No. 142.

(ELI LILLY & CO., INDIANAPOLIS, IND.)

	Guaranteed.	Found.
Nicotine	13.00	12.88

Cal. Dept. Agr., Spec. Pub. 75, 35 (1927).

Lime Hydrated.

Manufacturer or Distributor	Passing 300 mesh sieve
The Miller Co., Stockbridge Mass	84.00%

Conn. Agr. Exp. Sta., Sample 9509.

Limestone, Ground.

(MANUFACTURER UNKNOWN.)

Found: Magnesium oxide 30.86 per cent; calcium oxide 45.87 per cent.
Conn. Agr. Expt. Sta., Sample 8168.

Lime-Sulphur, Dry.

See Table XIV.

Lime-Sulphur Solution.

See Table XV.

Lion Brand Whale Oil Soap.

See "Soaps."

Liquid Insecticide.

(MERRITT CHEMICAL SPECIALTIES, OAKLAND, CAL.)

	Guaranteed.	Found.
Petroleum	94.00	92.00
Essential oils	6.00	present
Water	....	none

Cal. Dept. Agr., Spec. Pub. 34, 58 (1923).

Liquid Lice Killer.

See "A. R. M. Liquid Lice Killer".

Liquor Cresolis Compound.

See "Phenol Soap Solutions".

Lockman's Worm O-Tone.

(KIRK, GEARY & CO.)

	Guaranteed.	Found.
Water	75.00	77.00
Oil	....	22.76

Cal. Dept. Agr., Spec. Pub. 75, 64 (1927).

London Purple.

See Table XVI.

Long and Gretter's Squirrel Poison.

See "Strychnine Preparations".

TABLE XIV. LIME SULPHUR, DRY

Manufacturer or Distributor and Brand.	Total Sulphur.	Calcium Polysulphide		Calcium Thiosulphate		Free Sulphur.		Publication.
		Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	
	%	%	%	%	%	%	%	
Acme White Lead & Color Works, San Francisco, Cal. Acme	...	65.00	65.85	5.00	6.22	10.00	11.36	Cal. Dept. Agr., Spec. Pub. 75 32 (1927).
Bowker Chemical Co., New York N. Y.	59.10	. ..	....	....	....	....	....	N. J. Agr. Expt. Sta., Bull. 441 8 (1926).
California Rex Spray Co., Benicia, Cal. Horseshoe	....	63.00	72.62	5.00	9.16	12.00	6.76	Cal. Dept. Agr., Spec. Pub. 66, 23 (1926).
California Spray Chemical Co , Watsonville, Cal. Ortho	....	64.00	69.30	6.00	11.10	15.00	9.38	Cal. Dept. Agr., Spec. Pub. 75, 32 (1927).
W. C. Collins, San Francisco, Cal	....	....	53.91	....	....	....	....	Cal. Dept. Agr., Spec. Pub. 34, 30 (1923).
Devoe & Raynolds Co , New York, N. Y.	....	70.00	70.30	5.00	13.50	8.00	11.20	Ore. Agr. Expt. Sta., Cir. 84, 7 (1927).
The Dow Chemical Co., Midland, Mich..	....	64.00	67.04	6.00	12.92	15.00	9.94	Cal. Dept. Agr., Spec Pub. 75 32 (1927).
The Glidden Co., Cleveland, Ohio. Glidden	...	63.00	59.27	5.00	7.45	12.00	18.42	Cal. Dept. Agr., Spec. Pub. 58, 32 (1925).
The Glidden Co., Cleveland, Ohio. Glidden	....	71.00	52.45	5.00	10.64	8.00	21.35	Cal. Dept. Agr., Spec. Pub. 58, 32 (1925).
Grasselli Chemical Co.	....	....	61.10	....	6.85	. ..	8.23	Conn. Agr. Exp. Sta., Sample 9806.
Hemmingway's, Oakland, Cal	....	65.00	63.80	5.00	6.80	15.00	15.40	Ore Agr. Expt. Sta., Cir. 84, 7 (1927).
Interstate Chemical Co., Jersey City, N. J. Key	62.43	....	....	....	....	....	....	N. J. Agr. Expt. Sta., Bull. 441, 8 (1926).
Leggett & Bro , Inc., New York, N. Y..	60.79	....	....	....	....	....	....	N. J. Agr. Expt Sta., Bull. 441 8 (1926).
John Lucas & Co., Inc., Philadelphia, Pa. Lucas	....	70.00	64.44	5.00	6.38	10.00	13.08	Cal. Dept. Agr., Spec. Pub. 75, 32 (1927).

John Lucas & Co., Inc., Philadelphia, Pa. Lucas	....	65.00	64.27	5.00	8.80	15.00	13.00	Cal. Dept. Agr., Spec. Pub. 75, 32 (1927).
Montgomery Ward & Co., Portland, Ore.	....	70.00	64.00	5.00	8.70	10.00	12.00	Ore. Ag . Expt. Sta., Cir. 84, 7 (1927).
Chas. C. Navlet Co., San Jose, Cal. Navco	....	65.00	63.98	5.00	6.08	15.00	13.08	Cal. Dept Agr., Spec. Pub. 75, 32 (1927).
Nitrate Agencies Co., Bayonne, N. J.	60.88	....	....	...	....	....	....	N. J. Agr. Expt. Sta., Bull 459, 9 (1927).
Sherwin-Williams Co., Cleveland, Ohio. S.-W	....	65.00	62.31	5.00	6.26	15.00	14.25	Cal. Dept. Agr., Spec. Pub. 75, 32 (1927).
Sherwin Williams Co., Cleveland, Ohio. S.-W	....	60.00	62.68	5.00	6.08	20.00	13.56	Cal. Dept. Agr., Spec. Pub. 75, 32 (1927).
Sherwin-Williams Co., Cleveland, Ohio. S.-W	....	68.00	62.40	5.00	6.99	12.00	14.88	Cal. Dept. Agr., Spec. Pub. 75, 32 (1927).
Sherwin-Williams Co., Cleveland, Ohio. S.-W	....	63.00	66.15	5.00	6.36	12.00	14.60	Cal. Dept. Agr., Spec. Pub. 75, 32 (1927).
Sherwin-Williams Co., Cleveland, Ohio S.-W	....	65.00	66.43	5.00	6.36	10.00	11.68	Cal. Dept. Agr., Spec. Pub. 75, 32 (1927).
Sherwin-Williams Co., Cleveland, Ohio. S.-W	....	62.00	64.04	5.00	6.38	13.00	12.04	Cal. Dept. Agr., Spec. Pub. 75, 32 (1927).
E. H. Smith, Berkeley, Cal	25.02	....	33.05	....	6.10	...	35.36	Cal. Dept. Agr., Spec. Pub. 34, 30 (1923).

TABLE XV. LIME-SULPHUR SOLUTION

Manufacturer or Distributor and Brand.	Polysulphide Sulphur Found	Thiosulphate Sulphur Found	Total Sulphur		Calcium Polysulphide		Calcium Thiosulphate		Baumé Gravity, degrees		Publication.
			Guaranteed	Found	Guaranteed	Found	Guaranteed	Found	Guaranteed	Found	
	%	%	%	%	%	%	%	%			
W. A. Allen, Pittstown, N. J. Allen's Concentrated	....	....	....	18.17	....	....	....	....	....	24.00	N. J. Agr. Expt. Sta., Bull. 424, 10 (1925).
Banning Spray Mfg. Co., Banning, Cal.	....	....	....	....	....	21.10	....	7.90	....	30.00	Cal. Dept. Agr., Spec, Pub. 58, 27 (1925).
Bear Creek Spray Co., Medford, Ore.	....	....	....	22.90	....	24.20	....	....	30.00	29.10	Ore. Agr. Expt. Sta., Cir. 84, 6 (1927).
James A. Blanchard Co., New York, N. Y. Lion	....	....	....	....	24.00	25.04	1.00	2.13	....	30.00	Cal. Dept. Agr., Spec. Pub. 75, 30 (1927).
California Growers' Association, Inc., Los Angeles, Cal.	24.07	1.09	....	25.16	....	....	....	....	....	34.07	Cal. Dept. Agr., Spec. Pub. 34, 28 (1923).
California Paint Co., Oakland, Cal.	24.32	0.95	....	25.26	....	....	....	....	....	33.90	Cal. Dept. Agr., Spec. Pub. 34, 28 (1923).
California Rex Spray Co., Benicia, Cal. Rex	....	....	....	....	27.90	30.22	2.10	1.75	32.00	32.64	Cal. Dept. Agr., Spec. Pub. 75, 30 (1927).
California Spray Chemical Co., Watsonville, Cal. Ortho	....	....	....	....	28.00	30.30	2.00	1.75	....	32.75	Cal. Dept. Agr., Spec. Pub. 75, 30 (1927).
Chicken Pharmacy, Petaluma, Cal. C. P. Lice and Mite Liquid	....	....	....	....	....	35.34	....	1.52	....	35.00	Cal. Dept. Agr., Spec. Pub. 51, 10 (1925).
Chino Valley Apple Growers' Association, Chino, Cal.	....	....	....	....	26.50	22.22	3.50	6.84	30.00	29.70	Cal. Dept. Agr., Spec. Pub. 58, 27 (1925).
Lowell M. Clark. Home	....	....	....	....	28.00	28.52	1.00	2.12	....	31.75	Cal. Dept. Agr., Spec. Pub. 75, 30 (1927).

Cunningham & Thomas, Ukiah, Cal. C & T	....	...	....	....	30.00	28.32	2.00	2.43	30.00	31.00	Cal. Dept. Agr., Spec. Pub. 75, 30 (1927).
Farm Bureau Coop. Exchange, Eugene, Ore.	....	...	....	18.70	....	19.40	...	...	....	29.00	Ore. Agr. Expt. Sta., Cir. 84, 6 (1927).
T. A. Felton's, Portland, Ore	....	...	....	23.10	26.00	27.00	...	...	30.00	31.10	Ore. Agr. Expt. Sta., Cir. 64, 6 (1925).
F. A. Frazier Co	....	...	....	....	28.50	30.95	1.50	1.90	32.00	32.63	Cal. Dept. Agr., Spec. Pub. 66, 22 (1926).
General Chemical Co., San Francisco, Cal. Orchard	....	...	....	....	29.00	29.07	1.50	1.59	32.50	32.50	Cal. Dept. Agr., Spec. Pub. 75, 30 (1927).
General Chemical Co., San Francisco, Cal. Orchard	....	...	....	....	29.00	30.00	...	1.54	32.00	32.38	Cal. Dept. Agr., Spec. Pub. 75, 30 (1927).
Germain Seed & Plant Co., Los Angeles, Cal.[1]	....	...	25.00	25.54	....	31.31	...	1.75	....	33.50	Cal. Dept. Agr., Spec. Pub. 75, 30 (1927).
The Grasselli Chemical Co., New York, N. Y. Grasselli's	....	...	....	....	26.35	....	...	...	....	34.10	Conn. Agr. Expt. Sta., Bull. 272, 147 (1925).
Herbert & Herbert, Inc., Perth Amboy, N. J.	....	...	....	....	25.64	....	...	...	....	32.50	N. J. Agr. Expt. Sta., Bull. 441, 8 (1926).
Hood River Spray Co., Hood River, Ore.	....	...	24.00	24.70	....	27.10	...	...	32.00	31.00	Ore. Agr. Expt. Sta., Cir. 84, 6 (1927).
Hood River Spray Co., Hood River, Ore.	....	...	22.00	24.50	....	28.20	...	...	30.00	30.40	Ore. Agr. Expt. Sta., Cir. 84, 6 (1927).
Imperial Laboratories, Kansas City, Mo. Imperial Lice and Mite Remedy.	25.28	1.22	....	26.50	....	31.98	...	2.90	....	33.50	Cal. Dept. Agr., Spec. Pub. 34, 29 (1923).
J. G. Orchards, Newburg, Ore	....	...	....	22.70	....	24.00	...	...	30.00	29.10	Ore. Agr. Expt. Sta., Cir. 84, 6 (1927).
Leffingwell Rancho Co. X X X	....	...	....	....	30.00	30.62	1.50	2.00	32.00	33.00	Cal. Dept. Agr., Spec. Pub. 75, 30 (1927).
Leggett & Bro., Inc., New York, N. Y. Anchor	....	...	....	25.82	....	....	...	...	....	33.00	N. J. Agr. Expt. Sta., Bull. 441, 8 (1926).
B. Leis, Beaverton, Ore	..	...	24.00	24.10	....	26.70	...	...	30.00	30.20	Ore. Agr. Expt. Sta., Cir. 84, 6 (1927).

[1] Calcium oxide, guaranteed 10.00 per cent; found 9.85 per cent.

TABLE XV. LIME-SULPHUR SOLUTION—*Concluded*

Manufacturer or Distributor and Brand	Polysulphide Sulphur Found	Thiosulpate Sulphur Found	Total Sulphur		Calcium Polysulphide		Calcium Thiosulphate		Baumé Gravity, degrees		Publication
			Guaranteed	Found	Guaranteed	Found	Guaranteed	Found	Guaranteed	Found	
	%	%	%	%	%	%	%	%			
Los Angeles Chemical Co., Los Angeles, Cal. Mission	....	....	....	....	28.00	31.24	4.00	2.12	32.00	32.00	Cal. Dept. Agr., Spec. Pub. 66, 22 (1926).
A. R. Maas Chemical Co., Los Angeles, Cal.	....	....	....	....	28.50	29.92	1.50	2.43	....	32.50	Cal. Dept. Agr., Spec. Pub. 75, 30 (1927).
A. R. Maas Chemical Co., Los Angeles, Cal.[1]	13.80	4.80	20.00	18.60	....	....	....	....	30.00	35.10	Cal. Dept. Agr., Spec. Pub. 34, 29 (1923).
Mechling Bros. Chemical Co., Camden, N. J. Concentrated	....	....	25.00	25.68	....	....	....	....	....	32.50	N. J. Agr. Expt. Sta., Bull. 459, 8 (1927).
Miller Products Co., Portland, Ore.	....	....	22.10	24.60	....	26.20	....	....	30.00	32.30	Ore. Agr. Expt. Sta., Cir. 84, 6 (1927).
Montgomery Ward & Co.	....	....	....	24.50	26.40	26.20	....	....	30.00	32.40	Ore. Agr. Expt. Sta., Cir. 84, 6 (1927).
Murphy Oil Co., East Whittier, Cal.	12.95	3.39	....	16.34	....	19.55	....	8.05	....	25.00	Cal. Dept. Agr. Spec. Pub. 34, 29 (1923).
National Chemical Co., Pittsburgh, Pa. Flag	....	....	....	....	28.50	32.56	1.50	1.25	32.00	34.71	Cal. Dept. Agr., Spec. Pub. 75, 30 (1927).
Chas. C. Navlet Co., Inc., San Jose, Cal. Navco	....	....	....	....	....	31.73	....	1.34	32.00	32.80	Cal. Dept. Agr., Spec. Pub. 58, 28 (1925).
Parker's Laboratories, South Pasadena, Cal. Parker's Magic Discovery[2]	....	....	....	....	....	4.71	....	2.43	....	....	Cal. Dept. Agr., Spec. Pub. 51, 10 (1925).
Pomona Valley Lime & Sulphur Co. Gold Buckle	....	....	....	....	25.00	31.32	1.50	1.71	32.00	32.50	Cal. Dept. Agr., Spec. Pub. 75, 31 (1927).

San Jose Spray Mfg. Co., San Jose, Cal.[3]	....	...	....	....	....	30.65	. .	1.44	32.00	33.17	Cal. Dept. Agr., Spec. Pub. 75, 31 (1927).
Sherwin-Williams Co., Cleveland, Ohio. Hemmingway's	....	...	....	....	29.00	30.30	...	1.52	32.00	32.25	Cal. Dept. Agr., Spec. Pub. 75, 31 (1927).
Standard Chemical Works, Reading, Pa.	....	...	25.00	25.72	....	....	...	...	....	32.50	N. J. Agr. Expt. Sta., Bull. 459, 8 (1927).
Gideon Stolz, Salem, Ore	....	...	....	23.20	27.20	26.20	...	...	30.00	29.90	Ore. Agr. Expt. Sta., Cir. 84, 6 (1927).
Sutherlin Spray Plant, Sutherlin, Ore.	....	...	....	22.40	....	23.20	...	...	30.00	30.00	Ore. Agr. Expt. Sta., Cir. 84, 6 (1927).
S. Tinel, Yucaipa, Cal	15.39	3.46	....	18.35	....	19.33	...	8.21	....	29.50	Cal. Dept. Agr., Spec. Pub. 34, 29 (1923).
Valley Fruit Co., Walla Walla, Wash.	....	...	....	25.20	31.80	30.90	...	...	30.00	31.90	Ore. Agr. Expt Sta., Cir. 84, 6 (1927).
G. P. Weldon, Ontario, Cal	17.82	1.18	. .	19.00	....	....	...	...	....	27.00	Cal. Dept. Agr., Spec. Pub. 34, 28 (1923).
Yucaipa Valley Fruit Co. Mountain Boy	....	...	....	....	28.00	28.20	2.00	2.43	32.00	31.50	Cal. Dept. Agr., Spec. Pub. 75, 31 (1927).

[1] Calcium oxide 11.2 per cent; sodium chloride 0.12 per cent; potassium and sodium sulphates, 0.38 per cent; cyanogen compounds as ferrocyanide 3.13 per cent. Polysulphide sulphur guaranteed 11.69 per cent; thiosulphate sulphur guaranteed 5.21 per cent. Made with refuse gas-house lime.

[2] Sugar 0.46 per cent.

[3] Guaranteed water 70.00 per cent; calcium sulphate 1.00 per cent.

TABLE XVI. LONDON PURPLE

Manufacturer or Distributor and Brand	Total arsenic, metal		Water-soluble arsenic, metal		Publication
	Guaranteed	Found	Guaranteed.	Found	
	%	%	%	%	
Acme White Lead & Color Works, Detroit, Mich. Acme	26.00	25.42	0.30	0.17	Cal. Dept. Agr., Spec. Pub. 75, 26 (1927).
Sherwin-Williams Co., Cleveland, Ohio	21.00	24.08	1.50	0.75	Cal. Dept. Agr., Spec. Pub. 75, 27 (1927).

Lotol.

(GARDEN CHEMICAL CO., NEW YORK, N. Y.)

	Guaranteed.	Found.
Water	40.00	12.20

Cal. Dept. Agr., Spec. Pub. 66, 36 (1926).

M.

Maggi's Ant Poison.

(PAUL MAGGI, SANTA CLARA, CAL.)

	Guaranteed.	Found.
Sodium arsenate	0.20	0.26

Cal. Dept. Agr., Spec. Pub. 66, 19 (1926).

Maggotbait.

(CHAS. H. LILLY CO., SEATTLE, WASH.)

	Guaranteed.	Found.
Anthracene oil	0.80	1.40

Ore. Agr. Expt. Sta., Cir. 64, 15 (1925).

Magnesium Chloride, Flake.

(DOW CHEMICAL CO., MIDLAND, MICH.)

Found: Magnesium oxide 11.99 per cent; magnesium chloride ($MgCl_2$-$6H_2O$) 60.45 per cent. Nearly all water-soluble. Traces of iron, aluminum and calcium present.

Conn. Agr. Expt. Sta., Sample 6831.

Mag-O-Tite.

(RANDALL-MC LAUGHLIN, SEATTLE, WASH.)

	Guaranteed.	Found.
Total arsenic, metal	0.06	....
Water-soluble arsenic, metal	0.002	0.06
Naphthalene	4.39	6.35

Conn. Agr. Expt. Sta., Bull. 242, 159 (1922).

Mapco Miscible Oil.

See "Oil Emulsions, Mineral."

Mapco Nicotine Miscible Oil.

(MICHEL & PELTON CO.)

Found: Nicotine 0.90 per cent; soap 6.50 per cent; phenols 6.00 per cent; oils 79.30 per cent; water 6.20 per cent.

Cal. Dept. Agr., Spec. Pub. 75, 39 (1927).

Mapco Nicotine Spray.

(MICHEL & PELTON CO.)

	Guaranteed.	Found.
Nicotine	1.00	1.20
Soap	20.00	20.20
Water	78.00	75.20
Pine oil	1.00	....

Cal. Dept. Agr., Spec. Pub. 75, 39 (1927).

Mapco Rosin Soap for Spray.

See "Soaps."

Mapco Sheep Dip.

See "Phenol Soap Solutions."

Mapco Whale Oil Soap.

See "Soaps."

Marcol.

See "Oils, Mineral".

Marvel Ant Gelatin.

(H. W. MC SPADDEN)

	Guaranteed.	Found.
Arsenious oxide	0.10	0.11

Cal. Dept. Agr., Spec. Pub. 75, 24 (1927).

Mattes Ant Paste.

(L. A. MATTES.)

	Guaranteed.	Found.
Arsenic, metal	0.75	0.82

Cal. Dept. Agr., Spec. Pub. 75, 24 (1927).

McClellen's Sodium Fluoride.

See "Sodium Fluoride".

McNear's Poultry House Spray.

See "Oils, Mineral."

F. W. McNess Krenol Dip & Dininfectant.

See "Phenol Soap Solutions".

F. W. McNess Lice Powder and Insecticide.

(FURST-MC NESS CO., OAKLAND, CAL.)

	Guaranteed.	Found.
Nicotine	1.00	1.36
Naphthalene	9.00	11.90
Sulphur	9.50	10.30

Cal. Dept. Agr., Spec. Pub. 75, 40 (1927).

Mealy Bug Spray Oil.

See "Oil Emulsions, Mineral."

Mechling's Dry Mix.

(MECHLING BROS. CHEMICAL CO., CAMDEN, N. J.)

Guaranteed: Sulphur 60.00 per cent.

Found: Sulphur 60.93 per cent; coarser than 100 mesh, 2.23 per cent; passes 100 mesh, 97.77 per cent; 200 mesh, 25.13 per cent; 300 mesh, 3.03 per cent.

N. J. Agr. Expt. Sta., Bull. 459, 8 (1927).

Mechling's Green Label Hydroxide Paste.

(MECHLING BROS. MFG. CO., CAMDEN, N. J.)

	Guaranteed.	Found.
Water	....	56.30
Total arsenic, metal	3.25	2.70
Water-soluble, arsenic, metal	0.25	0.12
Copper	4.50	3.50
Lead oxide	....	9.95

N. J. Agr. Expt. Sta., Bull. 286, 13 (1915).

Mechling's P. T. B.

See "Paradichlorbenzene."

Mechling's Yellow Label Hydroxide Paste.

(MECHLING BROS. MFG. CO., CAMDEN, N. J.)

	Guaranteed.	Found.
Water	....	59.02
Total arsenic, metal	5.50	3.90
Water-soluble arsenic, metal	0.50	0.13
Copper	2.25	2.46
Lead oxide	....	17.55

N. J. Agr. Expt. Sta., Bull. 286, 13 (1915).

Medol Emulsion.

See "Oil Emulsions, Mineral."

Melrosine.

(THE GARDEN CHEMICAL CO., NEW YORK, N. Y.)

Guaranteed: Inert matter (water) not over 85 per cent.

Found: Chloroform extract 12.94 per cent; water 79.70 per cent; ash 2.93 per cent; fatty acids (oleic) 10.92 per cent. Potassium present, arsenic absent. Small amount of essential oil probably present. The solid matter is mostly potassium oleate.

Conn. Agr. Expt. Sta., Sample 8933.

Mercury Preparations, Organic.

See "Bayer Dipdust," "DuPont Semesan, Jr," "Semesan," "Semesan Bel" and "Uspulun".

Merit Lice Powder.

(TERRY PRODUCTS CO., PASADENA, CAL.)

Two samples:

Sample 1.

Found: Calcium hydroxide 59.08 per cent; calcium carbonate 17.64 per cent; calcium sulphate 0.34 per cent; magnesium carbonate 1.06 per cent; silica 12.80 per cent; iron and aluminum oxides 1.98 per cent; organic matter and water of constitution 6.72 per cent. Red coloring matter present.

Sample 2.

Guaranteed: Talc 67.00 per cent.

Found: Calcium carbonate 1.36 per cent; sodium carbonate 2.91 per cent; ferric oxide 0.66 per cent; water 3.61 per cent; phenols 3.60 per cent; naphthalene 8.44 per cent; talc 78.33 per cent.

Cal. Dept. Agr., Spec. Pub. 34, 57 (1923).

Merit Worm Expeller.

(TERRY PRODUCTS CO., PASADENA, CAL.)

Two samples:

Sample 1.

Found: Talc 40.62 per cent; magnesium sulphate 12.04 per cent; calcium sulphate 9.05 per cent; calcium silicate 6.85 per cent; Venetian red 7.34 per cent; sand 2.11 per cent; loss on ignition 21.18 per cent; nicotine 0.22 per cent.

Sample 2.

Found: Calcium hydroxide 1.55 per cent; magnesium sulphate 15.79 per cent; iron and aluminum oxides 6.00 per cent; sand 24.59 per cent; loss on ignition 51.60 per cent; nicotine 0.06 per cent.

Cal. Dept. Agr., Spec. Pub. 34, 58 (1923).

Mildew-Go.

See "Leggett."

Mildew Killer.

See "M. K."

Miko Argentine Ant Poison.

(OSGOOD BROS. DRUG STORES).

	Guaranteed.	Found.
Arsenious oxide	0.10	0.10
Arsenic, metal	0.075	0.08

Cal. Dept. Agr., Spec. Pub. 66, 19 (1926).

Mirto.

(H. HUNTER).

Found: Calcium hydroxide and calcium carbonate present, reaction alkaline.

Cal. Dept. Agr., Spec. Pub. 75, 66 (1927).

Miscible Oil.

Mission Brand Insecto No. 1.

See "Oil Emulsions, Mineral".

Mission Rat Poison.

See "Phosphorus Preparations."

Mixture 154 A Special.

Mixture S 155 A Special.

See "Nicotine-Sulphur Dusts."

Mixture M 163 Special.

Mixture No. 150.

Mixture No. 274 Special.

Mixture No. 221 Special.

See "Nicotine Dusts."

M. K. Mildew Killer (Unburnt Sulfur Ore).

(CHAS. A. LEE CO., KERMAN, CAL.)

Found: Moisture 2.68 per cent; free sulphur 48.15 per cent; free sulphuric acid 1.67 per cent; silica 43.50 per cent; iron and aluminum oxides 0.26 per cent; loss on ignition 3.12 per cent; passing 200 mesh sieve, 60.0 per cent.

Cal. Dept. Agr., Spec. Pub. 51, 58 (1925).

Modified Kil-Tone.

See "Bordeaux Mixture".

Moore's Prepared Squirrel Poison.

See "Strychnine Preparations".

David C. Moore U. C. Chicken Worm Capsules.

(PALMER DRUG CO.)

	Guaranteed.	Found.
Nicotine	13.00	13.46

Cal. Dept. Agr., Spec. Pub. 75, 35 (1927).

Moor Mans Stock and Poultry Dip and Disinfectant.

See "Phenol Soap Solutions."

Morehead's Ant Killer.

(MOREHEAD ANT KILLER CO., SAN FRANCISCO, CAL.)

	Guaranteed.	Found.
Tartar emetic	....	1.05
Glucose	23.18	large amount
Cane sugar	46.38	large amount
Water	26.09	25.27

Trace of arsenic present.

Cal. Dept. Agr. Spec. Pub. 34, 18 (1923).

Morse's Gopher Poison.

See "Strychnine Preparations."

Morse's Snail and Slug Destroyer.

(C. C. MORSE & CO., SAN FRANCISCO, CAL.)

	Guaranteed.	Found.
Crystallized potash alum	99.00	99.42

Cal. Dept. Agr., Spec. Pub. 75, 66 (1927).

Moth Exterminator and Ovicide.

(H. LIEBES CO., SAN FRANCISCO, CAL.)

Found: Naphthalene 87.20 per cent; aldehydes 12.00 per cent.

Cal. Dept. Agr., Spec. Pub. 34, 59 (1923).

Mulford Phosphorus Paste.

See "Phosphorus Preparations."

Muller's Grand Tobacco.

See "Tobacco Dusts."

Munn's Argentine Ant Poison.

(COFFIN-REDINGTON CO.)

	Guaranteed.	Found.
Arsenic, metal	0.15	0.21

Cal. Dept. Agr., Spec. Pub. 66, 19 (1926).

Edgar A. Murray Roach Doom.

(EDGAR A. MURRAY CO.)

Guaranteed: Inert ingredients: curcuma 5.00 per cent; sodium carbonate 2.00 per cent; sodium sulphate 2.00 per cent; sodium chloride 2.00 per cent; iron oxide 1.00 per cent; insoluble in acids, 2.00 per cent.

Found: Sodium fluoride 91.99 per cent.

Cal. Dept. Agr., Spec. Pub. 75, 62 (1927).

Mystic Spray Insecticide.

(MYSTIC MFG. CO., GLENDALE, CAL.)

	Guaranteed.	Found.
Water	3.00	0.05

Cal. Dept. Agr., Spec. Pub. 75, 64 (1927).

Mystic XX Spray.

See "Oils, Mineral."

N.

Nabob Oil.

See "Oils, Mineral."

Naco Bordeaux-Paris Green.

(NITRATE AGENCIES CO., NEW YORK, N. Y.)

	Guaranteed.	Found.
Cupric oxide	18.00	16.23
Total arsenious oxide	17.00	17.32
Water-soluble arsenious oxide	2.00	0.82

Conn. Agr. Expt. Sta., Bull. 242, 153 (1922).

Naco Brand Sulfur Dusting Mixture Formula No. 5

(NITRATE AGENCIES CO., BAYONNE, N. J.)

	Guaranteed.	Found.
Total arsenic, metal	1.95	2.22
Water-soluble arsenic, metal	0.50	0.23
Sulphur	70.00	67.12

N. J. Agr. Expt. Sta., Bull. 441, 16 (1926).

Naco Brand Sulphur Smoke Dusting Mixture.

(NITRATE AGENCIES CO., BAYONNE, N. J.)

	Guaranteed.	Found.
Sulphur	80.00	79.58

N. J. Agr. Expt. Sta., Bull. 441, 7 (1926).

Naco Dust Special.

(NITRATE AGENCIES CO., BAYONNE, N. J.)

	Guaranteed.	Found.
Total arsenic, metal	6.50	7.56
Water-soluble arsenic, metal	0.50	0.08
Copper	7.30	5.82

N. J. Agr. Expt. Sta., Bull. 459, 16 (1927).

Naco Kalibor.

See "Kalibor."

Naphicide.

(NITRATE AGENCIES CO., BAYONNE, N. J.)

	Guaranteed.	Found.
Nicotine	2.00	2.23

N. J. Expt. Sta., Bull. 407, 11 (1924).

Naptho.

(MILLER PRODUCTS CO., PORTLAND, ORE.)

	Guaranteed.	Found.
Naphthalene	9.10	9.8

Ore. Agr. Expt. Sta., Cir. 64, 15 (1925).

Naptholene.

(MILLER PRODUCTS CO., PORTLAND, ORE.)

	Guaranteed.	Found.
Naphthalene	85.00	89.00

Ore. Agr. Expt. Sta., Cir. 84, 15 (1927).

Navco Crude Oil Emulsion.

Navco Miscible Oil.

See "Oil Emulsions, Mineral."

Navco Weed Destroyer.

(CHAS. C. NAVLET CO., INC., SAN JOSE, CAL.)

	Guaranteed.	Found.
Arsenious oxide	30.00	31.48

Cal. Dept. Agr., Spec. Pub. 75, 25 (1927).

Navco Whale Oil Soap.

See "Soaps."

Neutral Emulsion.

See "Oil Emulsions, Mineral."

New Insect Destroyer.

(DEWANE BOGUE, MEDINA, N. Y.)

Found: The substance is largely kerosene oil.

N. Y. Agr. Expt. Sta., Bull. 284, 301 (1904).

New Jersey Dry-Mix-Sulfur-Lime.

(J. R. GILLAM & BRO., BURLINGTON, N. J.)

Guaranteed: Sulphur 62.00 per cent.

Found: Sulphur 55.58 per cent; coarser than 100 mesh, 5.70 per cent; passes 100 mesh, 94.30 per cent; 200 mesh, 35.00 per cent; 300 mesh, 1.80 per cent.

N. J. Agr. Expt. Sta., Bull. 459, 8 (1927).

New Jersey Dry Mix Sulfur-Lime.

(JERSEY ORCHARD SUPPLY CO., BURLINGTON, N. J.)

	Guaranteed.	Found.
Sulphur	62.00	66.74

N. J. Agr. Expt. Sta., Bull. 424, 10 (1925).

New Nicotine Contact Mixture.

See "Nicotine Dusts."

Niagara "All in One".

(NIAGARA SPRAYER CO., MIDDLEPORT, N.Y.)

	Guaranteed.	Found.
Copper	4.00	6.30
Total arsenic, metal	1.80	1.82
Water-soluble arsenic, metal	0.50	....
Nicotine	1.10	1.11
Sulphur	19.00	....

Guaranteed lead arsenate 9.5 per cent; Bordeaux mixture 19 per cent; inert matter 51.40 per cent.

Conn. Agr. Expt. Sta., Bull. 242, 157 (1922).

Niagara All-in-One Dust No. 6.

See "No. 6 All-in-One Dust."

Niagara A-1 Dust Mixture.

See "Nicotine Dusts."

Niagara Copodust.

See "Copodust."

Niagara Copotex.

(NIAGARA SPRAYER CO., MIDDLEPORT, N. Y.)

	Guaranteed.	Found.
Total arsenic, metal	6.25	6.58
Water-soluble arsenic, metal	0.50	0.27
Copper	6.80	6.62

N. J. Agr. Expt. Sta., Bull. 459, 13 (1927).

Niagara D. C. Dust No. 3.

(NIAGARA SPRAYER CO., MIDDLEPORT, N. Y.)

	Guaranteed.	Found.
Copper	6.80	8.40

Maine Agr. Expt. Sta., Official Inspections 122, 86 (1926).

Niagara D 18 Dust Mixture.

(NIAGARA SPRAYER CO., MIDDLEPORT, N. Y)

	Guaranteed.	Found.
Total arsenic, metal	6.25	7.02
Water-soluble arsenic, metal	0.50	0.20
Copper	6.80	6.70

N. J. Agr. Expt. Sta., Bull. 459, 14 (1927).

Niagara Dormant Dust.

See "Dormant Dust".

Niagara Dry Mix.

(NIAGARA SPRAYER CO., MIDDLEPORT, N. Y.)

	Guaranteed.	Found.
Sulphur	61.00	63.39

Cal. Dept. Agr., Spec. Pub. 75, 28 (1927).

Niagara D 6 Dust

(NIAGARA SPRAYER CO., MIDDLEPORT, N.Y.)

	Guaranteed.	Found.
Copper	6.80	6.94

Cal. Dept. Agr., Spec. Pub. 75, 43 (1927).

Niagara D 20 Dust.

(NIAGARA SPRAYER CO., MIDDLEPORT, N.Y.)

	Guaranteed.	Found.
Copper	6.80	6.99
Total arsenic, metal	4.74	5.10
Water-soluble arsenic, metal	0.50	0.04

Guaranteed: Monohydrated copper sulphate 19.00 per cent; calcium arsenate 13.30 per cent.

Cal. Dept. Agr., Spec. Pub. 75, 44 (1927).

Niagara D 25 Potato Dust.

(NIAGARA SPRAYER CO., MIDDLEPORT, N. Y.)

	Guaranteed.	Found.
Copper	8.60	8.90

Guaranteed: Monohydrated copper sulphate 24.00 per cent.

Conn. Agr. Expt. Sta., Bull. 258, 370 (1924).

Niagara Dust Mixture No. 3 with Nicotine.

See "Nicotine Dusts."

Niagara Dust Mixture with Sulphur and Nicotine.

See "Nicotine-Sulphur Dusts."

Niagara 85-15 Dusting Mixture.

(NIAGARA SPRAYER CO., MIDDLEPORT, N. Y.)

Guaranteed: Total arsenic 2.92 per cent; water-soluble arsenic not more than 0.50 per cent; sulphur 83.00 per cent; lead arsenate 14.70 per cent; inert matter 2.30 per cent.

Found: Total arsenic 3.02 per cent.

Conn. Agr. Expt. Sta., Bull. 242, 157 (1922).

Niagara 80-10-10 Mixture.

(NIAGARA SPRAYER CO., MIDDLEPORT, N.Y.)

Guaranteed: Total arsenic 1.95 per cent; water-soluble arsenic not more than 0.50 per cent; sulphur 78.00 per cent; lead arsenate 9.80 per cent; inert matter 12.20 per cent.

Found: Total arsenic 2.26 per cent.

Conn. Agr. Expt. Sta., Bull. 242, 157 (1922).

Niagara 80-20 Mixture.

(NIAGARA SPRAYER CO., MIDDLEPORT, N.Y.)

	Guaranteed.	Found.
Total arsenic, metal	3.90	4.67
Water-soluble arsenic, metal	0.50	0.18
Sulphur	77.00	79.26

Cal. Dept. Agr. Spec. Pub. 75, 27 (1927).

Niagara Entodust, No. 1

See "Arsenate of Lead."

Niagara "50-50".

See "50-50".

Niagara Kolodust.

See "Sulphur."

Niagara Koloform.

(NIAGARA SPRAYER CO., MIDDLEPORT, N.Y.)

Guaranteed: Sulphur 61.00 per cent.

Found: Sulphur 71.11 per cent; coarser than 100 mesh, 1.53 per cent; passes 100 mesh, 98.47 per cent; 200 mesh, 53.67 per cent; 300 mesh, 10.50 per cent.

N. J. Agr. Expt. Sta., Bull. 459, 8 (1927).

Niagara Kolotax.

(NIAGARA SPRAYER CO., MIDDLEPORT, N.Y.)

	Guaranteed.	Found.
Total arsenic, metal	1.95	2.16
Water-soluble arsenic, metal	0.50	0.15
Sulphur	77.00	88.52

N. J. Agr. Expt. Sta., Bull. 459, 13 (1927).

Niagara Mixture No. 150, 70-10-20.

(NIAGARA SPRAYER CO., MIDDLEPORT, N.Y.)

	Guaranteed.	Found.
Total arsenic, metal	1.95	1.90
Water-soluble arsenic, metal	0.50	0.20
Sulphur	67.00	69.85

N. J. Agr. Expt. Sta., Bull. 459, 15 (1927).

Niagara Mixture S 303.

Niagara New Nicotine Contact Mixture D-1

Niagara New Nicotine Contact Mixture D-11

Niagara Nicotine Contact Mixture.

See "Nicotine Dusts."

Niagara Nicotine Sulfur Dust No. 7.

See "Nicotine-Sulphur Dusts."

Niagara 90-10 Dusting Mixture (Pomodust).[1]

(NIAGARA SPRAYER CO., MIDDLEPORT, N.Y.)

	Guaranteed.	Found.	Guaranteed	Found.
Sulphur	88.00	87.79	87.00	89.73
Total arsenic, metal	1.95	1.84	1.76	1.84
Water-soluble arsenic, metal	0.50	0.24	0.50	0.12
Lead Arsenate	9.80	....	....	....

Conn. Agr. Expt. Sta., Bull. 258, 370 (1924) and *Bull.* 272, 146 (1925)

Niagara No. 4 Nicotine-Lime Dust.

Niagara No. 6 Dust Mixture, with Nicotine.

Niagara No. 10 Dust Mixture, with Nicotine.

See "Nicotine Dusts."

Niagara No. 3 Dust Mixture with Nicotine and Basic Lead Arsenate.

(NIAGARA SPRAYER CO., MIDDLEPORT, N.Y.)

	Guaranteed.	Found.
Nicotine	1.00	1.25
Total arsenic, metal	2.10	2.25
Water-soluble arsenic, metal	0.50	0.06
Lead oxide	....	12.50

Cal. Dept. Agr., Spec. Pub. 75, 38 (1927).

Niagara P. D. B. Paradichlorobenzene.

See "Paradichlorbenzene."

[1] Two Samples.

Niagara Potato Dust Mixture without Poison.

(NIAGARA SPRAYER CO., MIDDLEPORT, N.Y.)

Guaranteed: Copper 6.50 per cent; monohydrated copper sulphate 19.50 per cent; inert matter 80.50 per cent.

Found: Copper 7.56 per cent.

Conn. Agr. Expt. Sta., Bull. 242, 157 (1922).

Niagara 70-10-20 Mixture.

See "Niagara Mixture No. 150."

Niagara Soluble Sulphur Compound.

(NIAGARA SPRAYER CO., MIDDLEPORT, N.Y.)

Guaranteed: Sodium polysulphide 40.00 per cent; sodium thiosulphate 18.00 per cent; free sulphur 3.00 per cent; inert matter 39.00 per cent.

Found: Total sulphur 41.40 per cent, present mostly as thiosulphate and free sulphur. Not in original package and probably decomposed.

Conn. Agr. Expt. Sta., Bull. 258, 370 (1924).

Niagara Soluble Sulphur Solution.

See "Soluble Sulphur Solution."

Niagara Special Mixture M. 163.

(NIAGARA SPRAYER CO., MIDDLEPORT, N.Y.)

	Guaranteed.	Found.
Copper	10.40	10.90

N. J. Agr. Expt. Sta., Bull. 459, 15 (1927).

Niagara Special Mixture No. 161.

See "Special Mixture No. 161."

Niagara Special Mixture No. 274.

(NIAGARA SPRAYER CO., MIDDLEPORT, N.Y.)

	Guaranteed.	Found.
Total arsenic, metal	0.98	1.27
Water-soluble arsenic, metal	0.50	0.20
Sulphur	82.00	82.78

N. J. Agr. Expt. Sta., Bull. 459, 15 (1927).

Niagara Special Mixture No. 221

(NIAGARA SPRAYER CO., MIDDLEPORT, N.Y.)

	Guaranteed.	Found.
Total arsenic, metal	0.98	1.51
Water-soluble arsenic, metal	0.50	0.35
Sulphur	73.00	71.70

N. J. Agr. Expt. Sta., Bull. 459, 15 (1927).

Niagara Special Mixture 154 A.

Niagara Special Mixture S 155 A.

See "Nicotine-Sulphur Dusts."

Niagara Special 68.

(NIAGARA SPRAYER CO., MIDDLEPORT, N. Y.)

	Guaranteed.	Found.
Total arsenic, metal	1.94	2.31
Water-soluble arsenic, metal	....	0.20
Copper	3.93	4.10

Maine Agr. Expt. Sta., Official Inspections 114, 88 (1924).

Niagara Special 210 Dust Mixture.

(NIAGARA SPRAYER CO., MIDDLEPORT, N. Y.)

	Guaranteed	Found.
Total arsenic, metal	7.40	2.68
Water-soluble arsenic, metal	0.50	0.24
Copper	6.80	8.21

N. J. Agr. Expt. Sta., Bull. 459, 15 (1927).

Niagara Sulphur Dust.

See "Sulphur Dust."

Niagara Sulphur with 7 per cent Nicotine Solution.

Niagara Sulphur with 10 per cent Nicotine Solution.

See "Nicotine-Sulphur Dusts".

Niagara Vitedust.

See "Vitedust."

Nickel Carbonate.

(MANUFACTURER UNKNOWN)

Found:Nickel 44.64 per cent; nickel carbonate 90.28 per cent; trace of sulphate present.

Conn. Agr. Expt. Sta., Bull. 242, 160 (1922).

Nico Dust.

See "Nicotine Dusts."

Nico-Dust for Walnut Worm and Aphis.

(WALNUT GROWERS' SPRAY MFG. CO., LOS ANGELES, CAL.)

Guaranteed: Nicotine 0.40 per cent; basic lead arsenate 10.00 per cent; total arsenic 1.50 per cent; water soluble arsenic trace, inert matter (lime) 89.60 per cent.

Found: Nicotine 0.62 per cent; lead oxide 11.95 per cent; arsenic oxide 2.89 per cent; total arsenic 2.19 per cent; water-soluble arsenic 0.08 per cent.

Cal. Dept. Agr., Spec. Pub. 51, 50 (1925).

Nico Dust No. 75.

(NICO-DUST MFG. CO.)

	Guaranteed.	Found.
Total arsenic, metal	....	5.65
Water-soluble arsenic, metal	....	0.18
Calcium arsenate	22.00	15.05

Cal. Dept. Agr., Spec. Pub. 75, 27 (1927).

Nico Fume (Liquid).

See "Nicotine Sulphate Solutions."

"Nico-Fume" Paper.

(TOBACCO BY-PRODUCTS & CHEM. CORP., LOUISVILLE, KY.)

	Guaranteed.	Found.
Nicotine	20.00	21.10

Ore. Agr. Expt. Sta., Cir. 84, 10 (1927).

Nico Fume Tobacco Powder.

See "Nicotine Dusts."

Nico Garden Dust.

Nico Soap.

See "Nicotine Soaps."

Nico-Sulphur Dust No. 5.

Nico-Sulphur Dust No. 6.

Nico-Sulphur Dust No. 8.

See "Nicotine-Sulphur Dusts."

Nicota.

Nicoticide.

See "Nicotine Sulphate Solutions."

Nicotine Capsules.

(LANGLEY & MICHAELS).

	Guaranteed.	Found.
Nicotine	13.00	13.48

Cal. Dept. Agr., Spec. Pub. 75, 35 (1927).

Nicotine Contact Mixture.

See "Nicotine Dusts".

Nicotine Dusts.

See Table XVII.

Nicotine, Floral.

See "Nicotine Sulphate Solutions."

Nicotine-Lime Dust.

See "Nicotine Dusts."

Nicotine Miscible Oil.

(MICHEL & PELTON CO.)

Guaranteed: Water 10.00 per cent.

Found: Nicotine 1.00 per cent; soap 5.40 per cent; phenols 5.70 per cent; tar oil 21.10 per cent; mineral oil 61.60 per cent; water 4.00 per cent.

Cal. Dept. Agr., Spec. Pub. 75, 39 (1927).

Nicotine, Rose.

See "Nicotine Sulphate Solution."

Nicotine Soaps.

See Table XVIII.

Nicotine Spray.

See "Nicotine Soaps."

Nicotine-Sulfur-Lead Arsenate Dust.

(WALNUT GROWERS' SPRAY MFG. CO., LOS ANGELES, CAL.)

	Guaranteed.	Found.
Sulphur	60.00	44.19
Nicotine	1.90	1.55
Lead arsenate	10.00	0.27
Arsenic, metal	2.00	0.06
Inert matter	28.00	...

Cal. Dept. Agr., Spec., Pub. 34, 49 (1923).

TABLE XVII. NICOTINE DUSTS

Manufacturer, Distributor or Brand	Nicotine		Inert matter, Guaranteed	Fineness, finer than		Publication
	Guaranteed	Found		100 mesh	200 mesh	
	%	%	%	%	%	
Anaheim Feed & Fuel Co., Anaheim, Cal. Double Nico-Dust	. . .	2.71	....	....	....	Cal. Dept. Agr., Spec. Pub. 34, 44 (1922).
Bomberger Seed Co., Modesto, Cal. Double Nico-Dust	....	1.29	....	....	....	Cal. Dept. Agr., Spec. Pub. 34, 44 (1922).
Bomberger Seed Co., Modesto, Cal. Nico Dust[1]	....	1.04	....	....	....	Cal. Dept. Agr., Spec. Pub. 34, 42 (1922).
California Associated Raisin Co., Fresno, Cal. Double Nico-Dust[1]	....	1.40	....	....	....	Cal. Dept. Agr., Spec. Pub. 34, 44 (1922).
California Associated Raisin Co., Fresno, Cal. Nico-Dust[1]	. .	1.62	. .	....	....	Cal. Dept. Agr., Spec. Pub. 34, 42 (1922).
California Pest Control Co. Calpest Garden Dust	3.00	3.74	....	....	. .	Cal. Dept. Agr., Spec. Pub. 75, 36 (1927).
California Spray Chemical Co., Watsonville, Cal.[1]	2.00	1.84	95.00	....	....	Cal. Dept. Agr., Spec. Pub. 34, 42 (1922).
California Spray Chemical Co., Watsonville, Cal.	2.00	1.90	98.00	....	....	Cal. Dept. Agr., Spec. Pub. 34, 43 (1922).
California Spray Chemical Co., Watsonville, Cal. Ortho. Double	3.50	3.60	....	....	....	Cal. Dept. Agr., Spec. Pub. 75, 36 (1927).
California Spray Chemical Co., Watsonville, Cal. Ortho. Double	4.00	3.91	....	....	....	Cal. Dept. Agr., Spec. Pub. 75, 36 (1927).
California Spray Chemical Co., Watsonville, Cal. Ortho Double	3.60	3.45	....	....	....	Cal. Dept. Agr., Spec. Pub. 75, 36 (1927).
California Sprayer Co., Calispray Dust No. 12	1.70	1.70	....	....	....	Cal. Dept. Agr., Spec. Pub. 75, 36 (1927).
California Sprayer Co. Calispray Insecticide Dust No. 11	0.50	1.22	....	90.00	66.00	Cal. Dept. Agr., Spec. Pub. 66, 25 (1926).

California Sprayer Co. Calispray Insecticide Dust No. 15	2.40	2.32	....	85.50	72.50	Cal. Dept. Agr., Spec. Pub. 66, 25 (1926).
Dosch Chemical Co., Louisville, Ky. Dosch No. 6[1].	2.20	2.60	97.80	....	....	Cal. Dept. Agr., Spec. Pub. 34, 43 (1922).
Dosch Chemical Co., Louisville, Ky. Dosch No. 10 Nico-Dust[1]	3.80	3.27	96.20	....	....	Cal. Dept. Agr., Spec. Pub. 34, 42 (1922).
Hall Tobacco Chemical Co., New York, N. Y. Fumigator	12.50	9.80	....	....	....	Ore. Agr. Expt. Sta., Cir. 64, 11 (1925).
Heightstown Hardware Co., Heightown, N. J. Axfixo[2]	1.25	1.47	98.75	....	....	Conn. Agr. Expt. Sta., Bull. 258,371 (1924).
Insecticide Supply Co., Los Angeles, Cal. Dustall No. 3	0.90	1.33	....	....	....	Cal. Dept. Agr., Spec. Pub. 75, 36 (1927).
Insecticide Supply Co., Los Angeles, Cal. Dustall No. 6	2.00	2.30	....	....	....	Cal. Dept. Agr., Spec. Pub. 75, 36 (1927).
Insecticide Supply Co., Los Angeles, Cal. Dustall No. 8	2.75	3.48	....	....	....	Cal. Dept. Agr., Spec. Pub. 75, 36 (1927).
Insecticide Supply Co., Los Angeles, Cal. Dustall No. 10	3.50	3.58	....	....	....	Cal. Dept. Agr., Spec. Pub. 75, 36 (1927).
International Milling Co., Impco Extra Strong Insecticide Dust	2.50	1.89	....	79.00	59.00	Cal. Dept. Agr., Spec. Pub. 58, 36 (1925).
International Milling Co., Impco Insecticide Dust	2.00	1.95	....	86.00	64.00	Cal. Dept. Agr., Spec. Pub. 58, 36 (1925).
International Milling Co., Impco Strong Insecticide Dust	1.20	1.06	....	86.00	58.00	Cal. Dept. Agr., Spec. Pub. 58, 36 (1925).
Manufacturer unknown	....	2.81	....	....	....	Conn. Agr. Expt. Sta., Sample 9663.
Manufacturer unknown. Nicotine Sulphate Dust	....	3.25	....	....	....	Conn. Agr. Expt. Sta., Sample 4170.
Chas. C. Navlet Co., San Jose, Cal	2.00	3.91	....	....	....	Cal. Dept. Agr., Spec. Pub. 75, 36 (1927).
Niagara Sprayer Co., Middleport, N. Y. Niagara A-1 Dust Mixture	....	3.01	....	....	....	Cal. Dept. Agr., Spec. Pub. 75, 36 (1927).
Niagara Sprayer Co., Middleport, N. Y. Niagara Dust Mixture No. 3 with Nicotine	1.00	1.13	....	....	....	Cal. Dept. Agr., Spec. Pub. 75, 36 (1927).
Niagara Sprayer Co., Middleport, N. Y. Niagara Mixture S 303	1.00	1.35	....	93.00	82.00	Cal. Dept. Agr., Spec. Pub. 66, 25 (1926).

[1] Lime carrier.
[2] Total ash 96.50 per cent; insoluble ash 1.28 per cent; calcium oxide 31.85 per cent; magnesium oxide 23.57 per cent.

TABLE XVII. NICOTINE DUSTS—*Concluded.*

Manufacturer, Distributor or Brand	Nicotine		Inert Matter, Guaranteed	Fineness, finer than		Publication
	Guaranteed	Found		100 mesh	200 mesh	
	%	%	%	%	%	
Niagara Sprayer Co., Middleport, N. Y. Niagara New Nicotine Contact Mixture D-1	1.25	1.43	98.75	....	....	Conn. Agr. Expt. Sta., Bull. 258, 371(1924)
Niagara Sprayer Co., Middleport, N. Y. Niagara New Nicotine Contact Mixture D 11	1.25	1.49	....	....	....	Cal. Dept. Agr., Spec. Pub. 58, 36 (1925).
Niagara Sprayer Co., Middleport, N. Y. Niagara Nicotine Contact Mixture	2.20	2.38	....	....	....	Conn. Agr. Expt. Sta., Bull. 242, 155(1922).
Niagara Sprayer Co., Middleport, N. Y. Niagara No. 4 Nicotine-Lime Dust	1.90	1.95	....	....	....	Cal. Dept. Agr., Spec. Pub. 34, 43 (1922).
Niagara Sprayer Co., Middleport, N. Y. Niagara No. 6 Dust Mixture with Nicotine	2.00	2.38	....	90.00	80.00	Cal. Dept. Agr., Spec. Pub. 58, 36 (1925).
Niagara Sprayer Co., Middleport, N. Y. Niagara No. 10 Dust Mixture with Nicotine	3.25	3.89	....	89.00	72.00	Cal. Dept. Agr., Spec. Pub. 58, 36 (1925).
Niagara Sprayer Co., Middleport, N. Y. Nicotine-Lime Dust[1]	2.20	2.44	97.80	....	....	Cal. Dept. Agr., Spec. Pub. 34, 43 (1922).
Niagara Sprayer Co., Middleport, N. Y. Nicotine-Lime Dust	1.10	1.23	98.90	....	....	Cal. Dept. Agr., Spec. Pub. 34, 43 (1922).
Niagara Sprayer Co., Middleport, N. Y. Nicotine-Lime Dust	1.90	1.81	98.10	....	....	Cal. Dept. Agr., Spec. Pub. 34, 43 (1922).
Niagara Sprayer Co., Middleport, N. Y. Nicotine-Lime Dust	0.70	0.52	99.30	....	....	Cal. Dept. Agr., Spec. Pub. 34, 43 (1922).
Niagara Sprayer Co., Middleport, N. Y. No. 2 Niagara A-1 Dust	2.70	2.92	....	....	....	Cal. Dept. Agr., Spec. Pub. 75, 36 (1927).

Niagara Sprayer Co., Middleport, N. Y. No. 5[1]	1.75	1.76	98.25	....	....	Cal. Dept. Agr., Spec. Pub. 51, 48 (1925).
Nico-Dust Mfg. Co., Los Angeles, Cal. Nico-Dust No. 3	.095	0.99	....	....	....	Cal. Dept. Agr., Spec. Pub. 75, 36 (1927).
Nico-Dust Mfg. Co., Los Angeles, Cal. Nico-Dust No. 6	2.00	2.21	....	....	....	Cal. Dept. Agr., Spec. Pub. 75, 36 (1927).
Nico-Dust Mfg. Co., Los Angeles, Cal. Nico-Dust No. 8	2.75	3.84	....	....	....	Cal. Dept. Agr., Spec. Pub. 75, 36 (1927).
Nico-Dust Mfg. Co., Los Angeles, Cal. Nico-Dust No. 10	3.50	4.62	....	....	....	Cal. Dept. Agr., Spec. Pub. 75, 36 (1927).
San Jose Spray Mfg. Co., San Jose, Cal. S. J.	1.75	1.82	....	99.00	86.00	Cal. Dept. Agr., Spec. Pub. 58, 36 (1925).
Tobacco By-Products & Chem. Corp., Louisville, Ky. Black Leaf F 2	2.00	0.84	....	....	....	N. J. Agr. Expt. Sta., Bull. 441, 9 (1926).
Tobacco By-Products & Chem. Corp., Louisville, Ky. Nico Fume Tobacco Powder	12.50	12.71	....	....	....	Conn. Agr. Expt. Sta., Bull. 272, 147 (1925).
L. D. Waller Seed Co., Guadalupe, Cal. Nico-Dust[1]	....	3.20	....	....	....	Cal. Dept. Agr., Spec. Pub. 34, 42 (1922).
Walnut Growers Association. Double Nico-Dust	2.36	2.41	94.00	....	....	Cal. Dept. Agr., Spec. Pub. 34, 44 (1922).
Walnut Growers' Spray Mfg. Co., Los Angeles, Cal. Nico-Dust No. 2[1]	0.75	0.96	99.25	....	....	Cal. Dept. Agr., Spec. Pub. 51, 48 (1925).
Walnut Growers' Spray Mfg. Co., Los Angeles, Cal. Nico-Dust No. 5	1.50	1.60	....	....	....	Cal. Dept. Agr., Spec. Pub. 75, 36 (1927).
Walnut Growers' Spray Mfg. Co., Los Angeles, Cal.[1]	0.56	0.45	98.50	....	....	Cal. Dept. Agr., Spec. Pub. 34, 42 (1922).

[1] Lime carrier.

[2] Total ash 96.50 per cent; insoluble ash 1.28 per cent; calcium oxide 31.85 per cent; magnesium oxide 23.57 per cent.

TABLE XVIII. NICOTINE SOAPS

Manufacturer or Distributor and Brand	Nicotine		Soap		Water Found	Publication
	Guaranteed	Found	Guaranteed	Found		
	%	%	%	%	%	
Alhambra Spray Co., Alhambra, Cal. Alhambra Nico-Soap	....	1.68	....	16.90	....	Cal. Dept. Agr., Spec. Pub. 51, 49 (1925).
An-Fo Mfg. Co., Los Angeles, Cal. An-Fo Nicotine Spray[1]	0.80	0.95	12.50	9.80	83.40	Cal. Dept. Agr., Spec. Pub. 75, 39 (1927).
An-Fo Mfg. Co., Los Angeles, Cal. An-Fo Nicotine Spray[1]	1.00	1.10	12.50	16.40	77.80	Cal. Dept. Agr., Spec. Pub. 75, 39 (1927).
Benj. Hammond, Fishkill, N. Y. Thrip Juice[2]	0.12	0.47	37.70	41.89	53.06	N. Y Agr. Expt. Sta., Bull. 384, 298(1914).
Hammond Slug & Shot Works, Fishkill, N. Y. Thrip Juice[3]	1.00	2.11	37.70[4]	38.05[4]	....	Mich. Agr. Coll. Expt Sta., Spec. Bull. 74, 10 (1915).
The Charles H. Lilly Co., Seattle, Wash. Tobacco Soap	2.00	2.10	6.00	6.30	....	Ore. Agr. Expt. Sta., Cir. 84, 10 (1927).
Manufacturer Unknown. Sulfo-Tobacco Plant and Animal Soap	....	0.40	....	....	....	Cal. Dept. Agr., Spec. Pub. 34, 47 (1923).
Chas. C. Navlet Co., San Jose, Cal. Nico Whale Oil Soap	....	None	....	20.60	....	Cal. Dept. Agr., Spec. Pub. 34, 47 (1923).

[1] Pine oil guaranteed 1.50 per cent.
[2] Fatty acids and resin, found 32.46 per cent; combined alkali, guaranteed 7.80 per cent; found 9.43 per cent; unsaponified, found 5.05 per cent.
[3] Potash guaranteed 7.80 per cent; found 8.04 per cent.
[4] Includes resin.

Manufacturer or Distributor and Brand	Nicotine		Inert matter, Guaranteed	Publication
	Guaranteed	Found		
	%	%	%	
Detroit Nicotine Co., Detroit, Mich. "To-Bakine" Liquid	45.00	46.02	.....	Mich. Agr. Coll. Expt. Sta., Spec. Bull. 74, 9, (1915).
Germain Seed & Plant Co., Los Angeles, Cal. Floral Nicotine	10.00	11.14	90.00	Cal. Dept. Agr., Spec. Pub. 34, 52 (1922).
Hall Tobacco Chemical Co., St. Louis, Mo. Hall's	40.00	40.61	.....	Conn. Agr. Expt. Sta., Bull. 272, 147 (1925).
Kentucky Tobacco Products Co., Louisville, Ky. Black Leaf 40	40.00	41.95	60.00	Cal. Dept. Agr., Spec. Pub. 34, 52 (1922).
Montgomery, Ward & Co., Portland, Ore. Nicotine Sulfate	40.00	40.30	.....	Ore. Agr. Expt. Sta., Cir. 84, 10 (1927).
Nicotine Mfg. Co., St. Louis, Mo. Nikoteen	30.00	31.56	70.00	Cal. Dept. Agr., Spec. Pub. 34, 52 (1922).
Nicoteen Mfg. Co., St. Louis, Mo. 30% Nikoteen	30.00	30.77	.....	N. J. Agr. Expt. Sta., Bull. 441, 9 (1926).
Nicotine Production Corporation. N. P. C. Nicotine Sulphate	40.00	40.64	.....	Cal. Dept. Agr., Spec. Pub. 75, 34 (1927).
P. L. Palethorp Co., Owensboro, Ky. Nicoticide.	25.00	45.30	.....	N. Y. Agr. Expt. Sta., Bull. 348, 94 (1912).
Parke Davis & Co , Detroit, Mich. Rose Nicotine	10.00	11.19	.....	N. Y. Agr. Expt. Sta., Bull. 384, 297 (1914).
Purity Chemical Products Co. Santa Rosa Ca. Nicota[1]	2.00	2.33	.....	Cal. Dept. Agr., Spec. Pub. 75, 34 1927).
Scabcura Dip Co., Chicago Ill. Nikoteen	.....	26.01	.....	U. S. D. A Bur. Chem., Bull. 68, 47 (1902).
F. A. Thompson Co., Detroit, Mich. Rose Nicotine	10.00	9.92	.....	N. Y. Agr. Expt Sta., Bull. 384, 297 (1914).
Tobacco By-Products & Chemical Corp., Inc., Louisville, Ky. Black Leaf 40	40.00	40.54	.....	Conn. Agr Expt. Sta., Bull. 242, 154 (1922) and Bull. 272, 147 (1925).
Tobacco By-Products & Chemical Corp., Inc., Louisville, Ky. 40% Nicotine Sulphate	40.00	40.42	.....	N. J. Agr. Expt. Sta., Bull. 459, 7 (1927).
Tobacco By-Products & Chemical Corp., Inc., Louisville, Ky. Nico Fume (Liquid)	40.00	42.90	.....	Conn. Agr. Expt. Sta. Bull. 272, 147, (1925).

[1] Water guaranteed 85.00%; found 96.10%.

TABLE XX. NICOTINE-SULPHUR DUSTS

Manufacturer or Distributor and Brand	Nicotine		Free Sulphur		Combined sulphur, Found	Inert matter, Guaranteed	Fineness, finer than		Publication
	Guaranteed	Found	Guaranteed	Found			100 mesh	200 mesh	
	%	%	%	%	%	%	%	%	
American Milling & Warehouse Co. (defunct) Impco	....	0.29	....	49.98	....	....	78.00	52.00	Cal. Dept. Agr., Spec. Pub. 66, 24 (1926).
Bomberger Seed Co., Modesto, Cal.[1]	....	0.96	....	39.39	....	....	....	....	Cal. Dept. Agr., Spec. Pub. 34, 45 (1922).
California Associated Raisin Co., Fresno, Cal[1]	....	0.88	....	52.44	0.31	....	....	....	Cal. Dept. Agr., Spec. Pub. 34, 45 (1922).
The California Sprayer Co., Calispray Dust No. 1	1.70	1.30	72.00	73.85	. ..	....	....	....	Cal. Dept., Agr., Spec. Pub. 75, 37 (1927).
The California Sprayer Co. Calispray Dust No. 2	2.70	2.43	70.00	67.10	....	....	....	....	Cal. Dept. Agr., Spec. Pub. 75, 37 (1927).
The California Sprayer Co. Calispray Combined Insecticide and Fungicide Dust No. 3	3.30	3.50	68.00	64.60	....	....	....	...	Cal. Dept. Agr., Spec. Pub. 75, 37 (1927).
The Calispray Sprayer Co.[2]	1.60	1.87	71.00	66.55	....	3.40	....	....	Cal. Dept. Agr., Spec. Pub. 34, 46 (1922).
Dosch Chemical Co., Louisville, Ky. Dosch	1.80	1.81	58.00	60.16	....	40.20	....	....	Cal. Dept. Agr., Spec. Pub. 34, 46 (1922).
Dosch Chemical Co., Louisville, Ky. Dosch	2.00	4.03	....	54.58	....	....	..	....	Cal. Dept. Agr., Spec. Pub. 34, 46 (1922).
Dosch Chemical Co., Louisville, Ky. Dosch	2.00	1.55	59.00	58.00	....	39.00	....	....	Cal. Dept. Agr., Spec. Pub. 34, 46 (1922).
F. A. Frazier Co. Frazier's 5X[3]	1.50	1.52	40.00	35.70	....	....	....	....	Cal. Dept. Agr., Spec. Pub. 75, 37 (1927).

L. O. Haupt, Hanford, Cal.[1]	....	0.97	....	68.10	....	....	....	....	Cal. Dept. Agr., Spec. Pub. 34, 45 (1922).
Hood River Spray Co., Hood River, Ore. N. S. P. Dust	....	1.89	....	64.00	....	....	....	....	Ore. Agr. Expt. Sta., Cir. 84, 11 (1927).
C. C. Morse & Co., San Francisco, Cal.	....	1.31	....	65.65	....	....	....	....	Cal. Dept. Agr., Spec. Pub. 34, 46 (1922).
Niagara Sprayer Co., Middleport, N. Y. Niagara Dust Mixture with Sulphur and Nicotine No. 5	1.75	2.46	48.00	49.42	....	....	....	....	Cal. Dept. Agr., Spec. Pub. 75, 37 (1927).
Niagara Sprayer Co., Middleport, N. Y. Niagara No. 7	2.25	2.61	58.00	58.15	4.16	39.75	....	....	Cal. Dept. Agr., Spec. Pub. 51, 49 (1925).
Niagara Sprayer Co., Middleport, N. Y. Niagara Special Mixture 154A	1.75	2.32	58.00	62.02	....	....	95.00	73.00	Cal. Dept. Agr., Spec. Pub. 66, 24 (1926).
Niagara Sprayer Co., Middleport, N. Y. Niagara Special Mixture S155A	2.25	3.25	38.00	41.03	....	....	92.00	72.00	Cal. Dept. Agr., Spec. Pub. 66,24 (1926)
Niagara Sprayer Co., Middleport, N. Y. Niagara Sulphur with 7% Nicotine Solution [1]	2.55	2.59	66.00	68.57	1.40	....	....	....	Cal. Dept. Agr., Spec. Pub. 51, 49 (1925).
Niagara Sprayer Co., Middleport, N. Y. Niagara Sulphur with 10% Nicotine Solution[1]	3.75	3.27	63.00	64.13	2.14	....	....	....	Cal. Dept. Agr., Spec. Pub. 51, 49 (1925).
Niagara Sprayer Co., Middleport, N. Y. No. 10[1]	3.25	4.22	58.00	56.29	5.74	39.75	....	....	Cal. Dept. Agr., Spec. Pub. 51, 49 (1925).
San Francisco Sulfur Co., San Francisco, Cal.	....	0.26	....	46.17	....	....	....	....	Cal. Dept. Agr., Spec. Pub. 34, 45 (1922).
San Jose Spray Mfg. Co., San Jose, Cal.	3.50	2.51	50.00	45.15	....	....	....	....	Cal. Dept. Agr., Spec. Pub. 75, 37 (1927).
Standard Chemical Co., Oakland, Cal. Sulfur-Nicotine Compound[4]	1.20	1.24	43.00	47.00	....	49.80	....	....	Cal. Dept. Agr., Spec. Pub. 34, 48 (1922).
L. D. Waller Seed Co., Guadalupe, Cal.	2.84	1.45	13.10	66.09	....	....	....	....	Cal. Dept. Agr., Spec. Pub. 34, 46 (1922).

[1] Lime carrier.
[2] Calcium hydroxide guaranteed 24.00 per cent.
[3] Sulphur classed as inert matter on label.
[4] Soap guaranteed 6.00 per cent; found 4.60 per cent.

TABLE XX. NICOTINE-SULPHUR DUSTS—*Concluded.*

Manufacturer or Distributor and Brand.	Nicotine		Free Sulphur.		Combined sulphur, Found	Inert matter, Guaranteed	Fineness, finer than		Publication
	Guaranteed	Found	Guaranteed	Found			100 mesh	200 mesh	
	%	%	%	%	%	%	%	%	
Walnut Growers' Association[1]	0.96	1.01	50.00	....	....	....	....	....	Cal. Dept. Agr., Spec. Pub. 34, 45 (1922).
Walnut Growers' Spray Mfg. Co., Los Angeles, Cal. Nico Garden Dust	2.00	1.86	45.00	30.16	....	....	95.00	75.00	Cal. Dept. Agr., Spec. Pub. 66, 24 (1926).
Walnut Growers' Spray Mfg. Co., Los Angeles, Cal. Nico-Sulphur Dust No. 5	1.75	1.83	45.00	46.36	....	....	90.00	72.00	Cal. Dept. Agr., Spec. Pub. 58, 35 (1295).
Walnut Growers' Spray Mfg. Co., Los Angeles, Cal. Nico-Sulphur Dust No. 6	2.00	2.20	40.00	32.78	....	....	90.50	60.50	Cal. Dept. Agr., Spec. Pub. 66, 24 (1926).
Walnut Growers' Spray Mfg. Co., Los Angeles, Cal. Nico-Sulphur Dust No. 8	2.75	2.99	40.00	37.18	....	....	86.00	45.00	Cal. Dept. Agr., Spec. Pub. 66, 24 (1926).
Walnut Growers' Spray Mfg. Co., Los Angeles, Cal.[1]	3.70	2.78	48.10	49.99	....	....	....	...	Cal. Dept. Agr., Spec. Pub. 34, 45 (1922).
Walnut Growers' Spray Mfg. Co., Los Angeles, Cal.[1]	1.50	1.16	60.00	50.33	....	38.50	....	....	Cal. Dept. Agr., Spec. Pub. 34, 45 (1922).
Walnut Growers' Spray Mfg. Co., Los Angeles, Cal.[1]	1.96	1.80	50.00	50.26	....	44.00	....	....	Cal. Dept. Agr., Spec. Pub. 34, 45 (1922).
Walnut Growers' Spray Mfg. Co., Los Angeles, Cal.[1]	0.96	1.03	50.00	44.92	....	47.00	....	....	Cal. Dept. Agr., Spec. Pub. 34, 45 (1922).
Walnut Growers' Spray Mfg. Co., Los Angeles, Cal.[1]	2.36	1.01	25.00	28.71	0.52	69.00	....	....	Cal. Dept. Agr. Spec., Pub. 34, 45 (1922).

[1] Lime carrier.

Nicotine-Sulfur Paste.

(STANDARD CHEMICAL CO., OAKLAND, CAL.)

	Guaranteed.	Found.
Nicotine	1.20	1.56
Free sulphur	43.00	45.25
Combined sulphur	....	0.25
Soap	6.00	7.07
Inert matter (lime)	49.80	....

Cal. Dept. Agr., Spec. Pub. 34, 48 (1923).

Nicotine Sulphate Dust.

See "Nicotine Dusts."

Nicotine Sulphate Solution.

See Table XIX.

Nicotine-Sulphur Dusts.

See Table XX.

Nico-Tone.

(THE KIL-TONE CO., VINELAND, N. J.)

See also "Green Cross Nico-Tone."

	Guaranteed.	Found.
Nicotine	1.25	0.67

N. J. Agr. Expt. Sta., Bull. 407, 10 (1924).

Nico-Tone B.

(THE KIL-TONE CO., VINELAND, N. J.

	Guaranteed.	Found.
Nicotine	3.00	2.17

N. J. Agr. Expt. Sta., Bull. 407, 10 (1924).

Nico Whale Oil Soap.

See "Nicotine Soaps."

Nictone.

(PARKE, DAVIS & CO., DETROIT, MICH.)

Found: Nicotine 9.87 per cent.

N. Y. Agr. Expt. Sta., Bull. 384, 297 (1914).

Nikoteen.

See "Nicotine Sulphate Solution."

Nikoteen Aphis-Punk.

(NICOTINE MFG. CO., ST. LOUIS, MO.)

Guaranteed: Nicotine 700 grains per package.
Found: Nicotine 7.96 per cent; 239.5 grains per package.

N. Y. Agr. Expt. Sta., Bull. 348, 94 (1912).

90-10 Dusting Mixture.

See "Niagara 90-10 Dusting Mixture."

No-Mor-Fly

(NO-MOR PRODUCTS CO., LOS ANGELES, CAL.)

Found: Oil 100.00 per cent; water trace, ash none to 0.003 per cent. Wintergreen and cassia present.

Cal. Dept. Agr. Spec. Pub. 51, 56 (1925).

North State Insecticide.

(NORTH STATE INSECTICIDE CO., RICHMOND, VA.)

Found: Insoluble in hydrochloric acid, 24.91 per cent; cupric oxide 12.43 per cent; iron and aluminum oxides 13.98 per cent; calcium oxide 9.07 per cent; arsenious oxide 20.32 per cent; sulphur trioxide 12.95 per cent; acetic acid and water by difference, 6.34 per cent.

U. S. D. A., Bur. Chem. Bull. 68, 27 (1902).

Nox-A-Vermin.

(COAST CHEMICAL CO., LOS ANGELES, CAL.)

	Guaranteed.	Found.
Phenols	20.00	22.40

Cal. Dept. Agr., Spec. Pub. 34, 36 (1923).

Noxem Squirrel and Gopher Poison.

See "Strychnine Preparations."

Noxicide.

See "Phenol Soap Solutions."

Nox-Weed.

(C. W. MORRELL, LOS ANGELES, CAL.)

Found: Arsenious oxide 16.74 per cent; sodium hydroxide 26.80 per cent; sodium carbonate 42.00 per cent; sodium chloride small amount, chromic oxide 1.93 per cent.

Cal. Dept. Agr., Spec. Pub. 34, 20 (1923).

Nox Worm Dry Powdered.

(A. F. DINGLEY, SOUTH PORTLAND, ME.)

	Guaranteed.	Found.
Total arsenic, metal	16.00	19.82
Water-soluble arsenic, metal	5.00	0.25
Copper	4.00	5.30

Maine Agr. Expt. Sta., Official Inspections 122, 87 (1926).

N. S. P. Dust.

See "Nicotine-Sulphur Dusts."

No. 1 Niagara Entodust.

See "Arsenate of Lead."

No. 3 Dust.

(LEGGETT & BRO., INC., NEW YORK, N. Y.)

	Guaranteed.	Found.
Total arsenic, metal	16.00	16.30
Water-soluble arsenic, metal	0.50	0.04
Copper	....	4.85

N. J. Agr. Expt. Sta., Bull. 441, 12 (1926).

No. 3 Dust Mixture.

See "Nicotine Dusts."

No. 4 Nicotine-Lime Dust.

No. 5 Nicotine Dust.

No. 6 Dust Mixture with Nicotine.

No. 10 Dust Mixture with Nicotine.

See "Nicotine Dusts."

No. 6 All-in-One Dust.

(NIAGARA SPRAYER CO., MIDDLEPORT, N. Y.)

	Guaranteed.	Found.
Nicotine	1.00	1.14
Total arsenic, metal	1.76	2.10
Water-soluble arsenic, metal	0.50	0.26
Lead oxide	....	6.45
Sulphur	75.00	76.16

Cal. Dept. Agr. Spec. Pub. 75, 38 (1927).

No. 6 Disinfectant.

See "Phenol Soap Solutions."

Nu Rex O.

(CALIFORNIA REX SPRAY CO., SACRAMENTO, CAL.)

	Guaranteed.	Found.
Arsenic oxide	5.55	6.62
Copper	12.70	11.50

Ore. Agr. Expt. Sta., Cir. 84, 13 (1927).

Nyal Roach Powder.

(NYAL CO., SAN FRANCISCO, CAL.)

	Guaranteed.	Found.
Talc	55.00	46.32

Cal. Dept. Agr., Spec. Pub. 75, 63 (1927).

O

Oakland Ant Co.

(OAKLAND ANT EXTERMINATING CO., OAKLAND, CAL.)

Found: Arsenious oxide 0.29 per cent; arsenic, metal 0.22 per cent.

Cal. Dept. Agr., Spec. Pub. 66, 19 (1926).

Oil, Fish.

The U. S. Department of Agriculture recommends the following specifications for fish oil for spraying purposes:

The oil should be light pressed and unadulterated, and have the following specifications:

Saponification value	190 to 193
Iodine value	139 to 193
Specific gravity at 15° C.	0.927 to 0.933
Free fatty acid	Less than 5 per cent.

U. S. D. A., Dept. Bull. 1439 (1926).

Oil, Menhaden, Light Pressed

(MANUFACTURER UNKNOWN)

Found: Specific gravity, 15° C., 0.932; saponification number 187; iodine number 173; free fatty acids 3.46 per cent.

Conn. Agr. Expt. Sta., Sample 421.

Oils, Mineral.

See Table XXI.

Oil Emulsions, Mineral.

See Table XXII.

TABLE XXI. OILS, MINERAL

Manufacturer or Distributor and Brand	Oil	Baumé gravity, degrees	Specific gravity, 20° C.	Saybolt Viscosity, 100° C., seconds	Unsulphonated	Evaporation, 60-65° C.[1]	Cold Test	Publication
	%				%			
Associated Oil Co., San Jose, Cal. Avon Brown Neutral	100.00	21.80	....	....	63.20	....	....	Cal. Dept. Agr., Spec. Pub. 75, 65 (1927).
Associated Oil Co., San Jose, Cal. Crude Oil[2]	100.00	18.40	....	....	....	....	....	Cal. Dept. Agr., Spec. Pub. 34, 39 (1922).
J. R. Chase, San Jose, Cal. Crude Oil[3]	....	19.50	....	....	....	....	....	Cal. Dept. Agr., Spec. Pub. 51, 57 (1925).
G. F. Doleshal Products Co., Pasadena, Cal. Sure-Shot[4]	99.80[5]	39.60	....	....	75.90	....	....	Cal. Dept. Agr., Spec. Pub. 51, 57 (1925).
Hackney Chemical Co., Parlier, Cal. Di-Fli Home Spray	100.00	39.30	....	....	....	....	....	Cal. Dept. Agr., Spec. Pub. 58, 48 (1925).
Hockwald Chemical Co., San Francisco, Cal. Fli-Mo-Cide	100.00[6]	44.10	....	....	....	....	....	Cal. Dept. Agr., Spec. Pub. 58, 48 (1925).
Lacko Specialty Co., Inc., San Francisco, Cal. Fly Croke	100.00	43.50	....	....	....	....	....	Cal. Dept. Agr., Spec. Pub. 58, 48 (1925).
Lacko Specialty Co., Inc., San Francisco, Cal. Lilacko Spray	99.80	43.10	....	....	....	....	....	Cal. Dept. Agr., Spec. Pub. 58, 48 (1925).
Mailliard & Schmiedell, San Francisco, Cal. Chemco Insect and Germ Destroyer[7]	100.00	50.50	....	....	52.10[8]	....	....	Cal Dept. Agr., Spec. Pub. 51, 56 (1925).
Manufacturer unknown. Alcopol Oil	....	....	0.9201	222	56.20	3.22	+7°F.	Conn. Agr. Expt. Sta., Sample 6729.
Manufacturer unknown. No. 14 Mineral Oil	....	....	....	246	97.80	1.71	....	Conn. Agr. Expt. Sta., Sample 8213.
Manufacturer unknown. No. 15 Mineral Oil	....	....	....	90	92.80	1.38	....	Conn. Agr. Expt. Sta., Sample 8214.

Manufacturer unknown. No. 16 Mineral Oil	....	....	....	331	96.40	1.68	....	Conn. Agr. Expt. Sta., Sample 8215.
Manufacturer unknown. No. 14 Spray Oil	....	....	0.9306	604	56.00	1.77	+27°F.	Conn. Agr. Expt. Sta., Sample 6727.
Manufacturer unknown. No. 910 Spray Oil	....	....	0.9280	473	56.40	1.69	+16°F.	Conn. Agr. Expt. Sta., Sample 6728.
Mystic Mfg. Co., Glendale, Cal. XX Mystic XX Spray[9]	100.00	37.60	....	....	77.40	....	....	Cal. Dept. Agr., Spec. Pub. 58, 43 (1925).
Standard Oil Co. of New York. Socony Motor Oil—heavy	....	....	0.9148	915	39.60	0.73	+18°F.	Conn. Agr. Expt. Sta., Sample 6725.
Standard Oil Co. of New York. Socony Motor Oil—light	....	....	0.9073	291	62.40	1.26	+10°F.	Conn. Agr. Expt. Sta., Sample 6726.
Standard Oil Co. of New York. Socony Motor Oil—medium	....	....	0.9129	443	52.40	0.85	+16°F.	Conn. Agr. Expt. Sta., Sample 6724.
Standard Oil Co. of New Jersey. Acto	....	....	....	173	96.00	....	....	Conn. Agr. Expt. Sta., Sample 9369.
Standard Oil Co. of New Jersey. Marcol	....	....	....	96	96.00	....	....	Conn. Agr. Expt. Sta., Sample 9371.
Standard Oil Co. of New Jersey. Wyrol	....	....	....	140	96.00	....	....	Conn. Agr. Expt. Sta., Sample 9370.
Sun Oil Co., Philadelphia, Pa. XXX Pale Spindle Oil	....	....	0.9257	169	55.20	3.88	−27°F.	Conn. Agr. Expt. Sta., Sample 6723.
Sun Oil Co., Philadelphia, Pa. LIV Newport Pale	....	....	0.9307	224	54.80	3.04	+16°F.	Conn. Agr. Expt. Sta., Sample 6720.
Sun Oil Co., Philadelphia, Pa. LIX New York Red	....	....	0.9360	449	53.20	1.77	+28°F.	Conn. Agr. Expt. Sta., Sample 6722.

[1]See Scott, "Standard Methods of Chemical Analysis" 1st ed. p. 575.
[2]Light oils 4.00 per cent; medium oils 31.25 per cent; heavy oils 64.75 per cent.
[3]Distillation test: initial boiling-point 105° C.; distilling 105-200° C., 5.19 per cent; 200-250° C., 9.86 percent; 250-305° C., 15.30 per cent; residue 69.44 per cent. Trace of water. Asphalt.
[4]Guaranteed active ingredients 100.00 per cent.
[5]Water 0.2 per cent.
[6]Ash 0.002 per cent.
[7]Sample is a mixture of kerosene and gasoline with a little oil of wintergreen.
[8]Fraction boiling above 150° C.
[9]Precipitated chalk, guaranteed 0.34 per cent; none found. Water, trace.

TABLE XXI. OILS, MINERAL—*Concluded*

Manufacturer or Distributor and Brand	Oil	Baumé gravity, degrees	Specific gravity, 100° C., seconds	Saybolt Viscosity, 100° C., seconds	Unsulphonated	Evaporation 60–65° C.[1]	Cold Test	Publication
	%				%			
Sun Oil Co., Philadelphia, Pa. LXII Toledo Red	....	....	0.9347	332	53.40	2.22	+27°F.	Conn. Agr. Expt. Sta., Sample 6721.
Sun Oil Co., Philadelphia, Pa. XCI Sunoco Golden	....	....	0.9254	103	58.00	5.08	−27°F.	Conn. Agr. Expt. Sta., Sample 6714.
Sun Oil Co., Philadelphia, Pa. XCII Sunoco Golden	....	....	0.9395	196	76.60	2.44	−18°F.	Conn. Agr. Expt. Sta., Sample 6713.
Sun Oil Co., Philadelphia, Pa. XCV Sunoco Golden	.....	.....	0.9450	434	77.80	1.69	+14°F.	Conn. Agr. Expt. Sta., Sample 6710.
Sun Oil Co., Philadelphia, Pa. XCV Sunoco Golden	....	....	0.9518	652	75.00	1.58	+43°F.	Conn. Agr. Expt. Sta., Sample 6711.
Sun Oil Co., Philadelphia, Pa. XCVII Sunoco Golden	....	....	0.9705	907,219	54.20	0.71	+85°F.	Conn. Agr. Expt. Sta., Sample 6712.
The Texas Co. Aleph Oil	....	....	0.9313	291[10]	53.40	2.88	+21°F.	Conn. Agr. Expt. Sta., Sample 6715.
The Texas Co. Altair Oil	....	....	0.9342	463[11]	54.40	2.05	+18°F.	Conn. Agr. Expt. Sta., Sample 6717.
The Texas Co. Nabob Oil	....	....	0.9281	214[12]	54.00	3.57	+19°F.	Conn. Agr. Expt. Sta., Sample 6718.
The Texas Co. No. 776 Oil	....	....	0.9230	704[13]	55.40	1.93	+41°F.	Conn. Agr. Expt. Sta., Sample 6716.
Tidewater Oil Co. Tycol 122	....	....	0.9070	213	58.80	0.00	+21°F.	Conn. Agr. Expt. Sta., Sample 6719.
Van Winkle Coffee Co., San Francisco, Cal. Old Rip Van Winkle Fly Spray	100.00[14]	42.20	....	....	....	....	....	Cal. Dept. Agr., Spec. Pub. 58, 48 (1925).

[1]See Scott "Standard Methods of of Chemical Analysis" 1st ed. p. 575.
[10]Guaranteed 300.
[11]Guaranteed 500.
[12]Guaranteed 200.
[13]Guaranteed 780.
[14]Ash 0.011 per cent; water, trace.

O. K. Ant Paste.

(WESTERN WHOLESALE DRUG CO.)

Guaranteed: Arsenic 8.39 per cent.

Found: Arsenious oxide 11.33 per cent; arsenic, metal 8.58 per cent; invert sugar 21.45 per cent; sucrose 17.27 per cent; water 33.02 per cent.

Cal. Dept. Agr., Spec. Pub. 58, 17 (1925).

O-Kay Gopher Poison.

Okay Poisoned Wheat.

O.K. Squirrel Poison.

See "Strychnine Preparations."

Old Rip Van Winkle Fly Spray.

See "Oils, Mineral."

Ongman's Dip and Disinfectant.

See "Phenol Soap Solutions".

Orange Oil Emulsion.

Orchard Dormant Soluble Oil.

Ortho Apricot Oil.

Ortho Crude Oil Emulsion.

See "Oil Emulsions, Mineral."

Ortho Double Nicotine Dust.

See "Nicotine Dusts."

Ortho Garden Dust.

(CALIFORNIA SPRAY CHEMICAL CO., WATSONVILLE, CAL.)

	Guaranteed.	Found.
Nicotine	2.00	2.11
Arsenic oxide	4.00	3.82
Copper	2.50	2.54

Cal. Dept. Agr., Spec. Pub. 75, 38 (1927).

Ortho Gopher Poison.

See "Strychnine Preparations."

Ortho Kleenup.

Orthol.

See "Oil Emulsions, Mineral."

Ortho Liquid Soap.

See "Soaps."

Ortho Miscible Oil.

Ortho Orange Oil Emulsion.

See "Oil Emulsions, Mineral."

Ortho Paradichlorobenzene.

See "Paradichlorbenzene."

TABLE. XXII. OIL EMULSIONS, MINERAL

Manufacturer or Distributor or Brand	Oil		Phenols—Found	Soap—Found	Water		Ash other than Soap Ash—Found	Constants of Separated Oil			Publications
	Guaranteed	Found			Guaranteed	Found		Baumé Gravity, degrees	Saybolt Viscosity, 100° F., seconds	Unsulphonated	
	%	%	%	%	%	%	%			%	
J. Willis Adriance, Stockton, Cal. Germo	....	94.00	5.90	....	....	....	....	..	...	....	Cal. Dept. Agr., Spec. Pub. 34, 39 (1923).
Alhambra Spray Co. Alhambra Spray[1]	....	60.40	10.20	4.90	....	....	1.31	....	...	....	Cal. Dept. Agr., Spec. Pub. 34, 36 (1923).
American Soap Co., Oakland, Cal. American Jazz Spray[2]	70.00	66.00	....	4.05	....	....	....	28.00	...	....	Cal. Dept. Agr., Spec. Pub. 34, 37 (1923).
Anaheim Spray Chemical Co., Anaheim, Cal. Blue Ribbon Orchard Spray	....	79.50[3]	....	4.00	20.00	16.20	....	33.05	53	86.00	Cal. Dept. Agr., Spec. Pub. 75, 51 (1927).
Anaheim Spray Chemical Co., Anaheim, Cal. E. M. F. Orchard Spray	....	68.15	....	6.20	....	24.70	....	37.10	...	66.75	Cal. Dept. Agr., Spec. Pub. 66, 32 (1926).
Associated Oil Co., San Jose, Cal. Petrotine	83.00	86.30	....	....	....	12.60	....	29.80	...	87.60	Cal. Dept. Agr., Spec. Pub. 75, 48 (1927).
Balfour, Guthrie & Co., San Francisco, Cal. Orchard Dormant Soluble Oil	....	81.95	3.68[4]	5.28	13.00	8.00	0.81	20.80	...	52.00	Cal. Dept. Agr., Spec. Pub. 51, 37 (1925).
Balfour, Guthrie & Co., San Francisco, Cal. Soluble Oil Spray[5]	87.00	86.37	2.80	4.03	....	....	1.57	....	...	....	Cal. Dept. Agr., Spec. Pub. 34, 36 (1923).
Balfour, Guthrie & Co., Los Angeles, Cal. Universal Brand Neutral Emulsion	70.00	71.20	....	....	....	26.60	....	22.50	...	58.80	Cal. Dept. Agr., Spec. Pub. 75, 48 (1927).
Balfour, Guthrie & Co., Los Angeles, Cal. Universal Brand Triona	70.00	75.40	....	....	....	23.30	....	31.95	58	86.80	Cal. Dept. Agr., Spec. Pub. 75, 48 (1927).

Balfour, Guthrie & Co., Los Angeles, Cal. Universal Brand Triumph	....	86.60[3]	4.40	3.90	13.00[3]	5.00[3]	....	28.40	...	....	Cal. Dept. Agr., Spec. Pub. 75, 53 (1927).
Balfour, Guthrie & Co., Los Angeles, Cal. Universal Brand Triumph	87.00[3]	88.40[3]	4.80	3.50	....	3.90[3]	....	29.10	...	....	Cal. Dept. Agr., Spec. Pub. 75, 53 (1927).
Balfour, Guthrie & Co., Los Angeles, Cal. Universal Dormant Soluble Oil	....	85.70[3]	1.80	7.10	13.00[3]	3.80[3]	....	19.90	...	....	Cal. Dept. Agr., Spec. Pub. 75, 53 (1927).
Balfour, Guthrie & Co., San Francisco, Cal. Universal Mealy Bug Spray Oil	....	75.40	7.80	9.40	13.00	7.00	....	23.20	...	44.20	Cal. Dept. Agr., Spec. Pub. 66, 32 (1926).
Balfour, Guthrie & Co., Lindsay, Cal. Universal Medol Emulsion	70.00	66.40	....	....	....	30.20	....	28.20	...	52.70	Cal. Dept. Agr., Spec. Pub. 66, 30 (1926).
Bean Spray Pump Co., San Jose, Cal. Bean's Bug-Go, Crude	75.00[3]	77.05[3]	....	1.39	....	21.60	....	22.55	...	....	Cal. Dept. Agr., Spec. Pub. 66, 32 (1926).
David Burke & Co. Bejo Orchard Spray	....	89.40	....	2.00	30.00	6.80	....	40.10	...	76.90	Cal. Dept. Agr., Spec. Pub. 66, 32 (1926).
David Burke & Co. Pacific Orchard Spray	....	77.40	5.80	4.90	25.00	11.40	....	39.10	...	70.60	Cal. Dept. ,Agr., Spec. Pub. 66, 32 (1926).
California Pest Control Co. Calpest Summer Spray	80.00[3]	85.85[3]	....	....	....	13.15	....	31.10	...	....	Cal. Dept. Agr., Spec. Pub. 75, 48 (1927).
California Rex Spray Co., Benicia, Cal. Rex Emulso	75.00[3]	75.70[3]	....	1.40	....	22.40	....	24.20	...	19.40	Cal. Dept. Agr., Spec. Pub. 66, 33 (1926).
California Rex Spray Co., Benicia, Cal. Rex Miscible Oil, Heavy	....	80.40[3]	4.40	6.50	8.00[3]	8.30[3]	....	27.90	...	....	Cal. Dept. Agr., Spec. Pub. 75, 53 (1927).
California Rex Spray Co., Benicia, Cal. Rex Miscible Oil, Light	....	80.30[3]	3.70	6.20	8.00[3]	9.40[3]	....	29.20	...	....	Cal. Dept. Agr., Spec. Pub. 75, 53 (1927).
California Rex Spray Co., Benicia, Cal. Vulture Oil	75.00[3]	74.70[3]	....	1.60[6]	....	22.95[3]	....	30.15	...	63.00	Cal. Dept. Agr., Spec. Pub. 75, 51 (1927).

[1]Inert matter 24.60 per cent.

[2]Soap guaranteed 4.00 per cent; inert matter guaranteed 26.00 per cent; found 30.00 per cent; Baumé gravity of oil, guaranteed 30.00. Rosin present.

[3]Per cent by volume.

[4]Phenols guaranteed 87.00 per cent. This emulsion contains rosin.

[5]Inert matter guaranteed 13.00 per cent; found 6.00 per cent. Rosin present.

[6]Guaranteed 1.00 per cent.

TABLE XXII. OIL EMULSIONS, MINERAL—*Continued*

Manufacturer or Distributor or Brand	Oil		Phenols—Found	Soap—Found	Water		Ash other than Soap Ash—Found	Constants of Separated Oil			Publications
	Guaranteed	Found			Guaranteed	Found		Baumé Gravity, degrees	Saybolt Viscosity, 100°F., seconds	Unsulphonated	
	%	%	%	%	%	%	%			%	
California Spray Chemical Co., Watsonville, Cal. Kleenup Oil	....	77.10	....	....	....	21.80	0.07	22.70	...	45.50	Cal. Dept. Agr., Spec. Pub. 66, 30 (1926).
California Spray Chemical Co., Watsonville, Cal. Ortho-Apricot Oil	75.00	74.00	....	....	....	26.00	....	29.10	...	59.80	Cal. Dept. Agr., Spec. Pub. 66, 30 (1926).
California Spray Chemical Co., Watsonville, Cal. Ortho-Crude Oil Emulsion	75.00[3]	75.60[3]	....	....	....	22.70	....	22.10	...	38.80	Cal. Dept. Agr., Spec. Pub. 75, 49 (1927).
California Spray Chemical Co., Watsonville, Cal. Ortho-Kleenup Grade A[7]	....	....	....	....	....	....	0.29	....	102	53.20	Conn. Agr. Expt. Sta., Sample 8861.
California Spray Chemical Co., Watsonville, Cal. Ortho Kleenup Oil	....	....	....	....	....	....	....	....	102	55.60	Conn. Agr. Expt. Sta., Sample 8045.
California Spray Chemical Co., Watsonville, Cal. Ortho-Kleenup Oil, Grade B	75.00[3]	78.20[3]	....	....	....	21.65	....	21.85	...	58.40	Cal. Dept. Agr., Spec. Pub. 75, 48 (1927).
California Spray Chemical Co., Watsonville, Cal. Orthol	75.00[3]	77.50[3]	none	....	....	21.80[3]	0.13	40.60	...	94.50	Cal. Dept. Agr., Spec. Pub. 58, 42 (1925).
California Spray Chemical Co., Watsonville, Cal. Orthol Concentrate	80.00[3]	79.60[3]	....	....	....	18.70	....	30.70	...	86.80	Cal. Dept. Agr., Spec. Pub. 75, 49 (1927).
California Spray Chemical Co., Watsonville, Cal. Orthol-K (Heavy)	....	....	....	....	....	....	....	....	111	80.80	Conn. Agr. Expt. Sta., Sample 9743.
California Spray Chemical Co., Watsonville, Cal. Ortho Miscible Oil	85.00[3]	87.25[3]	2.72	6.14	....	3.65	....	21.55	...	50.90	Cal. Dept. Agr., Spec. Pub. 66, 33 (1926).

California Spray Chemical Co., Watsonville, Cal. Ortho Orange Oil Emulsion[8]	....	....	....	....	25.00	24.70	0.48	40.30	...	96.70	Cal. Dept. Agr., Spec. Pub. 51, 32 (1925).
California Spray Chemical Co., Watsonville, Cal. Ortho Orange Oil Emulsion[8]	75.00	80.30	....	....	25.00	18.20	0.51	40.80	...	95.90	Cal. Dept. Agr., Spec. Pub. 51, 32 (1925).
California Spray Chemical Co., Watsonville, Cal. Ortho Penetrating Oil Spray	75.00[3]	72.50[3]	1.90	none	....	25.10	....	25.40	...	53.80	Cal. Dept. Agr., Spec. Pub. 58, 44 (1925).
California Spray Chemical Co., Watsonville, Cal. Volck Concentrate	....	83.55	....	....	....	16.28	0.02	....	...	....	Conn. Agr. Expt. Sta., Sample 2504.
California Spray Chemical Co., Watsonville, Cal. Volck[9]	83.00	79.19	....	....	....	....	....	....	...	94.40	Conn. Agr. Expt. Sta., Sample 8934.
California Spray Chemical Co., Watsonville, Cal. Volck Emulsion	....	....	....	....	....	....	....	....	108	93.60	Conn. Agr. Expt. Sta., Sample 8047.
California Spray Chemical Co., Watsonville, Cal. Volck Light	83.00[3]	81.80[3]	....	....	....	17.95	....	34.00	50	95.60	Cal. Dept. Agr., Spec. Pub. 75, 49 (1927).
Carco Spray Co., Tacoma, Wash. Oil Emulsion	....	86.60	....	....	....	....	....	....	...	....	Ore. Agr. Expt. Sta., Cir. 84, 13 (1927).
Classen, Murfit & Co., Philadelphia, Pa. Keresol	....	80.00[10]	4.15	12.00	....	....	1.30	....	...	....	Conn. Agr. Expt. Sta., Bull. 258, 373 (1924).
Clarkson & Ford, New York, N. Y. Soluble Spray Oil[11]	....	85.10	....	....	....	....	....	....	...	....	Conn. Agr. Expt. Sta., Bull. 272, 148 (1925).
Coulson Poultry & Stock Food. Coulson's Poultry Spray	....	88.60	9.60[12]	....	....	0.10	0.04	26.20	...	38.40	Cal. Dept. Agr., Spec. Pub. 51, 45 (1925).
Eastbay Chemical Co., Emeryville, Cal. Zeno Miscible Oil Spray[13]	....	84.22	4.00	4.78	....	....	0.94	....	...	....	Cal. Dept. Agr., Spec. Pub. 34, 36 (1923).

[3]Per cent by volume.
[7]Total nitrogen, 0.15 per cent; ammonia (NH_3) 0.12 per cent; casein 0.19 per cent. This is an ammonium caseinate emulsion.
[8]Ash contains copper and calcium.
[9]Ammonia (NH_3), found 0.06 per cent.
[10]Kerosene.
[11]Specific gravity, 25° C., 0.9333; unsaponifiable matter 85.10 per cent. Rosin present. A light petroleum oil containing a sodium soap.
[12]Guaranteed 15.00 per cent. Sample does not contain rosin.
[13]Inert matter guaranteed 16.00 per cent, found 6.00 per cent.

TABLE XXII. OIL EMULSIONS, MINERAL—*Continued*

Manufacturer or Distributor or Brand	Oil		Phenols—Found	Soap—Found	Water		Ash other than Soap Ash—Found	Constants of Separated Oil			Publications
	Guaranteed	Found			Guaranteed	Found		Baumé Gravity, degrees	Saybolt Viscosity, 100°F., seconds	Unsulphonated	
	%	%	%	%	%	%	%			%	
Eastbay Chemical Co., Emeryville, Cal. Zeno Miscible Oil Spray[14]	....	83.00	4.20	....	....	....	....	....	...	....	Cal. Dept. Agr., Spec. Pub. 34, 36 (1923).
Herbicide Chemical Laboratories. Fumispray	54.57	53.99	....	3.13[15]	45.29	42.20	0.01	....	...	65.30	Cal. Dept. Agr., Spec. Pub. 51, 35 (1925).
Herbicide Chemical Laboratories. Fumispray	....	55.76	....	3.54	40.00	39.00	0.08	....	...	....	Cal. Dept. Agr., Spec. Pub. 51, 35 (1925).
Hood River Spray Co., Hood River, Ore. Oil Emulsion	84.00	90.70	....	....	....	....	....	....	...	....	Ore. Agr. Expt., Sta. Cir. 84, 13 (1927).
Hood River Spray Co., Hood River, Ore. Oil Emulsion	75.00	73.80	....	....	....	....	....	....	...	....	Ore. Agr. Expt. Sta., Cir. 84, 13 (1927).
Leffingwell Rancho Co., Whittier, Cal. XXX Heavy Emulsion	85.00[3]	87.80[3]	....	....	....	12.50	....	38.10	69	98.40	Cal. Dept. Agr., Spec. Pub. 75, 49 (1927).
Leffingwell Rancho Co., Whittier, Cal. XXX Medium Emulsion	85.00[3]	87.70[3]	....	....	....	12.40	....	33.50	63	88.80	Cal. Dept. Agr., Spec. Pub. 75, 49 (1927).
Los Angeles Chemical C., Los Angeles, Cal. Mission Brand Insecto No. 1	90.00[3]	91.10[3]	....	....	....	8.42	....	26.40	75	70.00	Cal. Dept. Agr., Spec. Pub. 75, 49 (1927).
Manufacturer unknown. Sulco-V. B.	....	....	3.97	....	....	....	....	....	...	....	Conn. Agr. Expt. Sta., Bull. 242, 162 (1922).
McClure Chemical Laboratories. Calox	....	89.20	3.33	4.00	16.00	2.87	....	29.00	...	56.50	Cal. Dept. Agr., Spec. Pub. 58, 44 (1925).
McClure Chemical Laboratories. Renol (Miscible Oil)	....	84.60	3.50	8.50	6.00	2.40	....	38.60	...	69.60	Cal. Dept. Agr., Spec. Pub. 58, 44 (1925).

G. P. McNear Co., Petaluma, Cal. Four and One Spray	....	92.70	7.20[16]	....	....	0.10	0.01	....	...	74.20	Cal. Dept. Agr., Spec. Pub. 51, 45 (1925).
G. P. McNear Co., Petaluma, Cal. McNear's Poultry House Spray	94.00	94.24	5.76[17]	....	....	trace	....	....	...	....	Cal. Dept. Agr., Spec. Pub. 75, 56 (1927).
Michel & Pelton Co., Mapco Miscible Oil	....	83.60	5.20	7.05	10.00	2.50	....	21.05	...	....	Cal. Dept. Agr., Spec. Pub. 75, 53 (1927).
Chas. C. Navlet Co., Inc., San Francisco, Cal. Navco Crude Oil Emulsion[18]	....	66.12	....	....	30.00[3]	31.60[3]	0.64	22.60	...	31.70	Cal. Dept. Agr., Spec. Pub. 51, 33 (1925).
Chas. C. Navlet Co., Inc., San Francisco, Cal. Navco Miscible Oil	....	85.40[3]	5.20	6.30	12.00[3]	2.80[3]	....	22.30	...	....	Cal. Dept. Agr., Spec. Pub. 75, 53 (1927).
Peerless Spray Chemical Co., Covina, Cal. Peerless Spray Emulsion	85.00[3]	85.27[3]	....	....	....	14.13	....	27.77	85	86.40	Cal. Dept. Agr., Spec. Pub. 75, 49 (1927).
Perfecto Spray Mfg. Co., Los Angeles, Cal. Perfecto Spray Oil	83.00[3]	85.73[3]	....	....	....	13.98	....	31.33	45	74.30	Cal. Dept. Agr., Spec. Pub. 75, 49 (1927).
B. G. Pratt, New York, N. Y. Pratt's Carboleine[19]	86.00	88.70	present	....	....	11.17	1.22	....	...	....	Conn. Agr. Expt. Sta., Bull. 272, 148 (1925).
Rochester Rex Co., Rochester, N. Y. Emulso	....	....	....	....	....	....	....	....	157	61.00	Conn. Agr. Expt. Sta., Sample 8235.
R. R. Rogers Chemical Co., "Cee-Pee-Dee" Carbolized Petroleum Distillate	....	79.78	19.32[20]	....	2.00	0.80	0.06	24.90	...	47.50	Cal. Dept. Agr., Spec. Pub. 51, 45 (1925).
San Jose Spray Mfg. Co., San Jose, Cal. Cot Oil	....	79.90[3]	0.10	....	30.00	18.50	0.21	30.60	...	62.20	Cal. Dept. Agr., Spec. Pub. 66, 31 (1926).
San Jose Spray Mfg. Co., San Jose, Cal. Crude Oil Emulsion	....	81.19[3]	0.20	....	....	19.01	0.44	19.30	...	....	Cal. Dept. Agr., Spec. Pub. 66, 31 (1926).

[3]Per cent by volume.
[14]Inert matter guaranteed 16.50 per cent; found 12.50 per cent.
[15]Guaranteed 0.14 per cent.
[16]Guaranteed 2.00 per cent.
[17]Guaranteed 4.80 per cent.
[18]Ether-insoluble matter (glue) 1.65 per cent. Rosin present.
[19]Guaranteed mineral oil 83.00 per cent; saponifiable oil 3.00 per cent; potassium oxide 1.00 per cent.
[20]Guaranteed 20.00 per cent.

TABLE XXII. OIL EMULSIONS, MINERAL—*Concluded.*

Manufacturer or Distributor or Brand	Oil		Phenols—Found	Soap—Found	Water		Ash other than Soap Ash—Found	Constants of Separated Oil			Publications
	Guaranteed	Found			Guaranteed	Found		Baumé Gravity, degrees	Saybolt Viscosity, 100° F., seconds	Unsulphonated	
	%	%	%	%	%	%	%			%	
San Jose Spray Mfg. Co., San Jose, Cal. Exelol	....	83.14[3]	....	....	25.00	15.62	....	22.53	...	68.80	Cal. Dept. Agr., Spec. Pub. 75, 49 (1927).
San Jose Spray Mfg. Co., San Jose, Cal. San Jose Summer Oil	80.00[3]	86.01[3]	....	....	....	13.58	....	30.60	106	100.00	Cal. Dept. Agr., Spec. Pub. 75, 49 (1927).
San Jose Spray Mfg. Co., San Jose, Cal. Skalene	....	78.54[3]	5.60	4.20	10.00	11.75	....	27.30	...	64.40	Cal. Dept. Agr., Spec. Pub. 66, 33 (1926).
San Jose Spray Mfg. Co., San Jose, Cal. Skalol	....	82.70[3]	4.60	5.30	10.00	6.20	....	21.20	...	....	Cal. Dept. Agr., Spec. Pub. 75, 53 (1927).
Santa Rosa Poultry Association, Santa Rosa, Cal. Sarpa Poultry Spray[21]	....	98.10	1.60	....	....	0.30	none	....	...	42.00	Cal. Dept. Agr., Spec. Pub. 51, 57 (1925).
Santa Rosa Poultry Association, Santa Rosa, Cal. Sarpa Poultry Spray	....	76.11	21.88	....	....	2.00	0.01	....	...	....	Cal. Dept. Agr., Spec Pub. 51, 57 (1925).
Sherwin-Williams Co., Cleveland, Ohio. Citro-Mulsion[22]	69.00	72.90	0.56	....	31.00	23.20	0.05	....	...	67.10	Cal. Dept. Agr., Spec. Pub. 51, 33 (1925).
Sherwin-Williams Co., Cleveland, Ohio. Citro-Mulsion[23]	73.00	72.87	0.38	....	....	23.80	0.08	....	...	63.40	Cal. Dept. Agr., Spec. Pub. 51, 33 (1925).
Sherwin-Williams Co., Cleveland, Ohio. Free Mulsion	....	85.70[24]	....	....	....	....	....	....	162	59.40	Conn. Agr. Expt. Sta., Sample 7776.
Sherwin-Williams Co., Cleveland, Ohio. Spray Mulsion	....	83.60	2.90	8.10	5.00	4.00	....	24.70	...	....	Cal. Dept. Agr., Spec. Pub. 75, 53 (1927).
Sherwin-Williams Co., Cleveland, Ohio. Summer Mulsion	75.00	74.90	....	....	....	24.40	....	36.50	...	95.20	Cal. Dept. Agr., Spec. Pub. 75, 50 (1927).

Sherwin-Williams Co., Cleveland, Ohio. Winter Mulsion	75.00	75.34	0.23	....	....	23.80	0.11	27.20	...	58.90	Cal. Dept. Agr., Spec. Pub. 66, 31 (1926).
Standard Oil Co. of Indiana. Dendrol[25]	....	....	....	....	....	....	....	....	142	62.80	Conn. Agr. Expt. Sta., Sample 7777.
Standard Oil Co. of Indiana. L 21 Oil[26]	....	....	....	....	....	....	0.06	....	193	60.80	Conn. Agr. Expt. Sta., Sample 8862.
Sterling Spray Co. S. O. S. Sterling Oil Spray	....	92.48	....	1.90	....	4.55	....	36.65	37	76.10	Cal. Dept. Agr., Spec. Pub. 75, 51 (1927).
Sun Co., Boston & New York. Sun Miscible Oil[27]	....	79.00	....	....	....	....	2.85	....	...	....	Conn. Agr. Expt. Sta., Bull. 258, 373 (1924).
Sun Oil Co., Philadelphia, Pa. Sunoco Spray Oil	....	....	....	....	....	....	....	....	374	46.00	Conn. Agr. Expt. Sta., Sample 8046.
Van Antwerp Drug Corp., Mobile, Ala. Schnarr's Insecticide[28]	....	49.13	....	....	....	33.68	1.44	....	...	....	Conn. Agr. Expt. Sta., Bull. 258, 373 (1924).

[3]Per cent by volume.
[21]Specific gravity, 0.89002.
[22]Ether-insoluble (gums) 2.05 per cent.
[23]Ether-insoluble (gums) 2.18 per cent.
[24]Cc per 100 gm.
[25]Alcohol 0.23 per cent.
[26]Total nitrogen 0.03 per cent, ammonia nitrogen 0.01 per cent.
[27]Unsaponifiable matter 79.00 per cent; saponified matter 16.00 per cent.
[28]Total fatty acids 8.25 per cent; free fatty acids 0.77 per cent.

Ortho Penetrating Oil Spray.

See "Oil Emulsions, Mineral."

Ortho Penetrating Poisoned Barley.

See "Strychnine Preparations."

Ortho Poison Brand.

(CALIFORNIA SPRAY CHEMICAL CO., WATSONVILLE, CAL.)

	Guaranteed.	Found.
Arsenious oxide	7.10	6.90
Arsenic, metal	1.75	5.22

Cal. Dept. Agr., Spec. Pub. 51, 18 (1925).

Ortho Walnut Worm and Aphis Dust.

(CALIFORNIA SPRAY CHEMICAL CO., WATSONVILLE, CAL.)

	Guaranteed.	Found.
Nicotine	0.90	1.17
Total arsenious oxide	3.00	3.22
Total arsenic, metal	1.96	2.10
Water-soluble arsenic, metal	....	0.06
Lead oxide	....	10.00

Cal. Dept. Agr., Spec. Pub. 75, 38 (1927).

Ortho Walnut Worm Dust.

(CALIFORNIA SPRAY CHEMICAL CO., WATSONVILLE, CAL.)

	Guaranteed.	Found.
Arsenic	1.96	1.72

Cal. Dept. Agr., Spec. Pub. 75, 26 (1927).

Ortho Weed Killer.

(CALIFORNIA SPRAY CHEMICAL CO., WATSONVILLE, CAL.)

	Guaranteed.	Found.
Arsenious oxide	29.00	29.73

Cal. Dept. Agr., Spec. Pub. 75, 25 (1927).

Ortho Whale Oil Soap.

See "Soaps."

Otaylite.

(MANUFACTURER NOT STATED)

Found: Water 8.20 per cent; soap 14.38 per cent; free sulphur 8.13 per cent; sodium carbonate 22.50 per cent; silica 28.46 per cent; iron and aluminum oxides 1.40 per cent; calcium carbonate 13.05 per cent; magnesium carbonate 3.48 per cent. No arsenic or lead present.

Cal. Dept. Agr., Spec. Pub. 34, 59 (1923).

The Owl Argentine Ant Poison.

(THE OWL DRUG CO., SACRAMENTO, CAL.)

	Guaranteed.	Found.
Arsenic	0.20	0.18

Cal. Dept. Agr., Spec. Pub. 75, 24 (1927).

Owl Prussic Acid.

See "Hydrocyanic Acid".

The Owl Sheep Dip.

See "Phenol Soap Solutions."

"Oxygenic" Powder.

(OXYGENIC INDUSTRIAL CO., LOS ANGELES, CAL.)

Found: Water 7.48 per cent; copper sulphate ($CuSO_4.5H_2O$) 28.45 per cent; calcium oxide 32.12 per cent; gypsum 11.29 per cent; ammonium chloride 4.59 per cent; potassium chloride 3.42 per cent; sodium chloride 0.50 per cent; magnesium chloride 2.85 per cent; magnesium sulphate 3.10 per cent; silica 2.40 per cent; iron and aluminum oxides 0.58 per cent; carbon dioxide 3.22 per cent.

Cal. Dept. Agr., Spec. Pub. 34, 60 (1923).

P.

Pacific R & H Hydrocyanic Acid.

See "Hydrocyanic Acid."

Panama Spray Compound.

(CENTER PHARMACY, OAKLAND, CAL.)

No statement of active or inert ingredients. Not analyzed.

Cal. Dept. Agr., Spec. Pub. 66, 36 (1926).

Paracide.

See "Paradichlorbenzene."

Paradichlorbenzene.

See Table XXIII.

Paragrene.

(FRED L. LAVANBURG, NEW YORK, N. Y.)

Found: Cupric oxide 23.46 per cent; combined arsenious oxide 17.52 per cent; free arsenious oxide 23.08 per cent; acetic acid 6.72 per cent; gypsum 19.31 per cent, sodium sulphate 2.26 per cent; sodium chloride 0.25 per cent; ferric oxide 0.20 per cent; moisture 6.20 per cent. The substance is a mixture of Paris green, gypsum and white arsenic.

Univ. of Cal. Coll. of Agr., Expt. Sta., Bull. 151, 23 (1903).

Paris Green.

See Table XXIV.

Parker's Magic Discovery.

See "Lime-Sulphur Solution."

Par'Oidium.

(F. C. BOUCHER & CO., ST. PAUL, MINN., IMPORTERS).

Found: Ash insoluble in hydrochloric acid 7.10 per cent; carbon dioxide 2.88 per cent; sulphur trioxide 17.12 per cent; ferric oxide 10.63 per cent; calcium oxide 15.58 per cent; magnesium oxide 0.73 per cent; free sulphur 19.12 per cent; tobacco and water (by difference) 26.84 per cent. Substance is a mixture of gypsum, sulphur, ferric oxide, small amounts of sand, and tobacco.

U. S. D. A., Bur. Chem., Bull. 68, 54 (1902).

TABLE XXIII. PARADICHLORBENZENE

Manufacturer or Distributor and Brand	Paradichlorbenzene		Melting Point °C.	Publication
	Guaranteed	Found		
	%	%		
Braun-Knecht-Heimann, San Francisco, Cal....	99.00	98.80	.....	Ore. Agr. Expt. Sta., Cir. 84, 14 (1927).
California Spray Chemical Co., Watsonville, Cal. Ortho.....	99.00	98.50	.....	Cal. Dept. Agr., Spec. Pub. 75, 65 (1927).
Hooker Electrochemical Co., Paracide..	100.00	99.70	.....	Cal. Dept. Agr., Spec. Pub. 75, 66 (1927),
Mechling Bros. Mfg. Co. Camden, N. J. Mechling's P. T. B.	.....	.....	56	Conn. Agr. Expt Sta., Bull. 242, 160 (1922).
Niagara Alkali Co. Niagara P. D. B.[1].....	.....	99.17	53.2	Cal. Dept. Ag ., Spec. Pub. 51 56 (1925).
Southern California Disinfecting Co., Los Angeles Cal. Cedar Blocks.....	100.00	93.60	.....	Cal. Dept. Agr., Spec. Pub. 75, 66 (1927).

[1] No ash.

Manufacturer or Distributor and Brand	Arsenic Oxide				Cupric Oxide Found	Publication
	Total		Water-Soluble			
	Guaranteed	Found	Guaranteed	Found		
	%	%	%	%	%	
Acme White Lead & Color Works, Detroit, Mich...	50.00	57.50	....	1.00	24.60	Ore. Agr. Expt. Sta., Cir. 84, 9 (1927).
Bowker Chemical Co., New York, N. Y.....	50.00	55.23	3.50	1.15	29.55	N. J. Agr. Expt. Sta., Bull. 459, 5 (1927).
Brunswig Drug Co. Pfeiffer's.....	50.00	57.01	3.50	5.30	....	Cal. Dept. Agr., Spec. Pub. 75, 23 (1927).
Chipman Chemical Engineering Co., Inc., Bound Brook, N. J. Chipman.....	50.00	55.17	3.50	0.64	31.28	N. J. Agr. Expt. Sta., Bull. 459, 5 (1927).
Le Comptoir Co-Opératif Fédéré de Québec, Montreal, Can.....	....	55.48	....	1.15	30.42	Canada Dept. Agr., Div. Chem., Rept. Dominion Chemist (1928).
Dupuy & Ferguson, Montreal, Can.....	....	56.99	....	1.17	30.07	Canada Dept. Agr., Div. Chem., Rept. Dominion Chemist (1928).
The Glidden Co., Cleveland, Ohio. Glidden.....	50.00	55.32	3.50	2.47	....	Cal. Dept. Agr., Spec. Pub. 75, 23 (1927).
Interstate Chemical Co., Jersey City, N. J. Key..	50.00	55.04	3.50	1.15	31.60	N. J. Agr. Expt. Sta., Bull. 459, 5 (1927).
Fred. J. Lavanburg Co., New York, N. Y. Star....	50.00	55.68	3.50	3.26	....	Cal. Dept. Agr., Spec. Pub. 75, 23 (1927).
John Lucas & Co., Inc., Philadelphia, Pa. John Lucas	50.00	55.58	3.50	3.07	....	Cal. Dept. Agr., Spec. Pub. 75, 23 (1927).
Lucas-Kil-Tone Co., Vineland, N. J. Green Cross..	50.00	54.53	3.60	2.43	31.68	N. J. Agr. Expt. Sta., Bull. 459, 5 (1927).
Martin-Senour Co., Chicago, Ill.....	50.00	54.33	3.50	1.65	30.19	N. J. Agr. Expt Sta., Bull. 424, 7 (1925).
Montgomery, Wa d & Co., Oakland, Cal.....	50.00	56.72	3.50	2.06	....	Cal. Dept. Agr., Spec., Pub. 75, 23 (1927).
Nitrate Agencies Co., Bayonne, N. J. Naco.....	50.00	54.34	3.50	1.50	30.01	N. J. Agr. Expt. Sta., Bull. 407, 7 (1924).
Pfeiffer Insecticide Co., Inc., New York, N. Y. Bug	50.00	53.15	3.50	1.65	29.80	N. J. Agr. Expt. Sta., Bull. 424, 7 (1925)
Sherwin-Williams Co., Cleveland, Ohio. Sherwin-Williams.....	50.00	55.83	3.50	2.74	....	Cal. Dept. Agr., Spec. Pub. 75, 23 (1927).
Sherwin-Williams Co., Cleveland, Ohio. Hemmingway's.....	50.00	55.42	3.50	1.10	....	Cal. Dept. Agr., Spec. Pub. 75, 23 (1927).
Snow & Nealley, Bangor, Me.....	....	57.20	....	3.02	....	Maine Agr. Expt Sta., Official Inspections 126; 84 (1927).
Walnut Growers' Spray Mfg. Co. Golden State.....	50.00	55.73	3.50	2.37	....	Cal. Dept. Agr., Spec. Pub. 75, 23 (1927).
Western Wholesale Drug Co. Devoe.....	50.00	56.69	3.50	2.24	....	Cal. Dept. Agr., Spec. Pub. 75, 23 (1927).
Western Wholesale Drug Co. Star.....	50.00	57.81	3.50	1.98	....	Cal. Dept. Agr., Spec. Pub. 75, 23 (1927).

P. B. K.

(JOHN LUCAS & CO., INC., PHILADELPHIA, PA.)

(See also "Green Cross P. B. K.")

	Guaranteed.	Found.
Total arsenic, metal	21.30	21.24
Water-soluble arsenic, metal	1.00	1.64
Copper	6.00	9.00

N. J. Agr. Expt. Sta., Bull. 407, 14 (1924).

P. D. Q. Argentine Ant Solution.

See "Hirschey."

P. D. Q. Insect Powder.

(WORCESTER COMPOUND CO., WORCESTER, MASS.)

Found: Moisture 2.62 per cent; free sulphur 15.59 per cent; ash insoluble in hydrochloric acid 64.51 per cent; ash soluble in hydrochloric acid 15.23 per cent; coal-tar products (by difference) 2.05 per cent; calcium, magnesium, potassium, sodium, sulphate and phosphate present. A mixture of sulphur, coal-tar products and earth.

U. S. D. A., Bur. Chem., Bull. 68, 49 (1902).

Peerless Spray Emulsion.

Penetrating Oil Spray.

See "Oil Emulsions, Mineral."

Perfecto Rosin Paste.

See "Soaps."

Perfecto Spray Oil.

See "Oil Emulsions, Mineral."

Pest-Go.

(PEST-GO, INC., PORTLAND, ORE.)

	Guaranteed.	Found.
Active salts	70.00	68.80

Ore. Agr. Expt. Sta., Cir. 84, 15 (1927).

Pestroy.

See "Bordeaux Mixture-Lead Arsenate."

Peterman's Roach Food.

(WM. PETERMAN, NEW YORK, N. Y.)

Found: Borax 20.60 per cent; balance potato or pea meal and red coloring matter.

U. S. D. A., Bur. Chem., Bull. 68, 43 (1902).

Petrotine.

See "Oil Emulsions, Mineral."

Pheno-Dip.

See "Phenol Soap Solutions."

Phenol.

See Table XXV.

Phenolene.

See "Phenol Soap Solutions."

TABLE XXV. PHENOL

Manufacturer or Distributor and Brand	Phenols		Water	Non-Soap Ash	Oils	Constants of Separated Oil		Publication
	Guaranteed	Found				Baumé Gravity, Degrees	Unsulphonated	
	%	%	%	%	%		%	
Braun-Knecht-Heimann Co., San Francisco, Cal. Acid Carbolic, Crude	....	24.60	0.50	....	....	....	....	Cal. Dept. Agr., Spec. Pub. 58, 46 (1925).
Braun-Knecht-Heimann Co., San Francisco, Cal. Hercules Carbolic Acid	....	33.60	1.00	....	65.40	....	....	Cal. Dept. Agr., Spec. Pub. 75, 56 (1927).
Germain Seed & Plant Co. Germain Crude Carbolic Acid[1]	15.00	14.70	0.40	....	82.80	23.50	22.50	Cal. Dept. Agr., Spec. Pub. 58, 46 (1925).
Hayward Drug Co., Hayward, Cal. Crude Carbolic Acid	....	22.00	0.60	0.13	75.66	0.80	39.03	Cal. Dept. Agr., Spec. Pub. 51, 44 (1925).
A. R. Maas Laboratories. Crude Carbolic Acid	....	14.92	trace	0.05	84.48	0.70	trace	Cal. Dept. Agr., Spec. Pub. 51, 44 (1925).
Mefford Chemical Co., Los Angeles, Cal. Crude Carbolic Acid	....	37.70	1.60[2]	trace	59.60	12.30	7.20	Cal. Dept. Agr., Spec. Pub. 51, 44 (1925).
Peterson Bros., Hayward, Cal. Waters Bros. Crude Carbolic Acid[1]	.....	17.00	0.20	....	80.50	20.80	36.10	Cal. Dept. Agr., Spec. Pub. 58, 46 (1925).
R.R. Rogers Chemical Co., San Francisco, Cal. Crude Carbolic Acid	40.00	42.00	14.00	....	44.00	....	....	Cal. Dept. Agr., Spec. Pub. 75, 56 (1927).
R.R. Rogers Chemical Co., San Francisco, Cal. Crude Carbolic Acid 25 per cent.	25.00	26.92	1.60	0.03	70.98	1.60	3.60	Cal. Dept. Agr., Spec. Pub. 51, 44 (1925).
Rogers Pharmacy, Hayward, Cal. Crude Sol. Carbolic Acid	....	12.60	trace	0.07	86.50	25.50	49.80	Cal. Dept. Agr., Spec. Pub. 51, 44 (1925).

[1] Adulterated with mineral oil.
[2] Guaranteed none.

TABLE XXVI. PHENOL SOAP SOLUTIONS

Manufacturer or Distributor and Brand	Phenols		Soap		Water		Non-Soap Ash	Oils			Publication
	Guaranteed	Found	Guaranteed	Found	Guaranteed	Found		Total	Tar	Mineral	
	%	%	%	%	%	%	%	%	%	%	
Acme White Lead & Color Works, Detroit, Mich. Acme Sheep & Cattle Dip	....	10.70	....	24.30	10.00	10.40	0.60	....	52.00	....	Cal. Dept. Agr., Spec. Pub. 75, 57 (1927).
An-Fo Mfg. Co., Los Angeles, Cal. An-Fo Disinfectant	....	16.10	....	21.81	10.00	9.60	2.09	....	49.25	....	Cal. Dept. Agr., Spec. Pub. 75, 57 (1927).
An-Fo Mfg. Co., Los Angeles, Cal. An-Fo Sheep Dip	....	17.30	....	20.90	10.00	8.20	1.05	....	50.40	....	Cal. Dept. Agr., Spec. Pub. 75, 57 (1927).
H. L. Atkinson, San Francisco, Cal. At-Ko Sheep Dip	....	22.20	....	5.86	10.00	2.00	0.35	....	68.29	....	Cal. Dept. Agr., Spec. Pub. 75, 57 (1927).
Buker's Bird Store, San Francisco, Cal. Buker's Sheep Dip	....	25.10	....	14.40	10.00	6.40	....	....	22.70	29.40	Cal. Dept. Agr., Spec. Pub. 75, 57 (1927).
Coffin-Redington Co., San Francisco, Cal. Creo Fenol Sheep Dip	....	14.00	....	16.00	10.00	8.00	0.50	....	59.70	....	Cal. Dept. Agr., Spec. Pub. 75, 57 (1927).
The G. E. Conkey Co., Cleveland, Ohio. Conkey's Noxicide[1,2]	....	16.80	....	23.30	9.00	8.60	0.60	49.20	....	....	Cal. Dept. Agr., Spec. Pub. 51, 45 (1925).
Economy Hog & Cattle Powder Co. Economy Germicide Dip	....	15.90	....	14.20	10.00	6.60	1.20	....	60.90	....	Cal. Dept. Agr., Spec. Pub. 75, 57 (1927).
W. P. Fuller & Co. Fuller's Carbolic Insecticide Sheep Dip	9.10	13.00	6.00	7.90	....	29.80	4.80	....	45.00[3]	....	Cal. Dept. Agr., Spec. Pub. 75, 57 (1927).
W. P. Fuller & Co. Fuller's Sheep Dip and Cattle Wash	9.15	11.00	24.94	7.60	....	15.30	2.40	....	63.20[4]	....	Cal. Dept. Agr., Spec. Pub. 75, 57 (1927).
Furst-McNess Co., Oakland, Cal. F. W. McNess Krenol Dip & Disinfectant	....	19.40	....	26.20	8.00	8.00	0.50	....	43.60	....	Cal. Dept. Agr., Spec. Pub. 75, 57 (1927).

Germain Seed & Plant Co., Los Angeles, Cal. Cann's Canco	....	10.25	....	20.57	10.00	14.10	1.06	....	52.68	....	Cal. Dept. Agr., Spec. Pub. 75, 58 (1927).
Germo Mfg. Co. Germo Carboline	....	9.50	....	13.60	12.00	12.00	0.70	....	62.60	....	Cal. Dept. Agr., Spec. Pub. 75, 58 (1927).
Germo Mfg. Co. Germo Cresosote Dip	....	12.40	....	14.70	12.00	7.40	....	....	63.00	....	Cal. Dept. Agr., Spec. Pub. 75, 58 (1927).
Germo Mfg. Co. Germo Sheep Dip	....	11.30	....	19.60	12.00	10.40	0.60	....	55.70	....	Cal. Dept. Agr., Spec. Pub. 75, 58 (1927).
Heinrich Chemical Co., Oakland, Cal. Ongman's Dip & Disinfectant	....	12.50	....	10.30	8.00	5.80	1.70	....	25.80	44.00	Cal. Dept. Agr., Spec. Pub. 75, 58 (1927).
Dr. Hess & Clark. Dr. Hess Dip and Disinfectant	14.00	14.93	20.00	19.07	9.50	8.87	1.25	....	54.03[5]	....	Cal. Dept. Agr., Spec. Pub. 75, 58 (1927).
Hockwald Chemical Co. Hockwald's Sheep Dip	....	14.50	....	17.80	12.00	7.80	0.50	....	56.80	....	Cal. Dept. Agr., Spec. Pub. 75, 58 (1927).
Kirk, Geary & Co. Kirk Geary Dipsol Sheep Dip	16.00	25.30	....	14.10	7.00	4.60	0.10	....	28.70[6]	26.70	Cal. Dept. Agr., Spec. Pub. 75, 58 (1927).
Langley & Michaels Co. Cresolite Sheep Dip	. .	16.60	. .	22.70	10.00	10.80	. .	. .	48.30	. .	Cal. Dept. Agr., Spec. Pub. 75, 58 (1927).
Langley & Michaels Co., Germosol Special Disinfectant	....	58.80	....	20.10	20.00	17.00	3.70	....	....	....	Cal. Dept. Agr., Spec. Pub. 75, 58 (1927).
Dr. LeGear Medicine Co., St. Louis, Mo. Dr. LeGear's Dip and Disinfectant[1,7]	....	12.51	....	18.90	12.00	10.80	0.20	55.97	....	....	Cal. Dept. Agr., Spec, Pub. 51, 45 (1925).
Arthur R. Maas Chemical Co. Cresylol	....	14.76	....	15.60	15.00	10.60	0.43	....	....	57.95	Cal. Dept. Agr., Spec. Pub. 75, 58 (1927).
Mefford Chemical Co. Sheep Dip	....	3.50	....	....	10.00	9.20	....	....	....	....	Cal. Dept. Agr., Spec. Pub. 51, 45 (1925).

[1]Contains rosin.
[2]Sp. Gr. of oil, Baumé, 3.10. Unsulphonated, trace.
[3]Guaranteed 54.40 per cent.
[4]Guaranteed 36.60 per cent.
[5]Guaranteed 53.00 per cent.
[6]Guaranteed 65.00 per cent.
[7]Sp. Gr. of oil, Baumé, 2.95. Unsulphonated, 1.80 per cent.

TABLE XXVI. PHENOL SOAP SOLUTIONS—*Continued*

Manufacturer or Distributor and Brand	Phenols		Soap		Water		Non-Soap Ash	Oils			Publication
	Guaranteed	Found	Guaranteed	Found	Guaranteed	Found		Total	Tar	Mineral	
	%	%	%	%	%	%	%	%	%	%	
Michel & Pelton Co., San Francisco, Cal. Liquor Cresolis Compound...	50.00	52.43	....	....	21.00	21.18	....	....	....	....	Cal. Dept. Agr., Spec. Pub. 51, 43 (1925).
Michel & Pelton Co., San Francisco, Cal. Liquor Cresolis Compound .	....	47.75	....	....	15.00	16.00	....	....	....	....	Cal. Dept. Agr., Spec. Pub. 51, 43 (1925).
Michel & Pelton Co., San Francisco, Cal. Liquor Cresolis Compound...	....	53.03	....	....	21.00	19.85	....	....	....	....	Cal. Dept. Agr., Spec. Pub. 51, 43 (1925).
Michel & Pelton Co., San Francisco, Cal. Mapco Sheep Dip.....	....	18.70	....	8.60	10.00	2.20	0.30	....	28.30	40.00	Cal. Dept. Agr., Spec. Pub. 75, 59 (1927).
Moorman Mfg. Co. Moor Mans Stock & Poultry Dip & Disinfectant[1,9]	....	23.12	....	30.20	8.00	8.20	0.16	36.99	....	....	Cal. Dept. Agr., Spec. Pub. 51, 44 (1925).
H. K. Mulford Co. Krelos.....	....	28.70	....	13.70	10.00	9.00	1.80	....	45.60	....	Cal. Dept. Agr., Spec. Pub. 75, 59 (1927).
Ness & Co., Darlington, England. Thymo-Cresol[9].....	....	....	....	....	....	....	....	....	....	....	U. S. D. A., Bur. Chem. Bull. 68, 57 (1902).
No-Vermo Mfg. Co. Sol-o-cree[1, 10]..	....	6.00	....	18.80	10.00	9.80	0.40	63.20	....	....	Cal. Dept. Agr., Spec. Pub. 51, 45 (1925).
The Owl Drug Co. The Owl Sheep Dip.....	....	20.00	.....	14.20	10.00	8.00	1.50	....	55.70	....	Cal. Dept. Agr., Spec. Pub. 75, 59 (1927).
Pacific Chemical Co., Los Angeles, Cal. Licresol.....	50.00	50.75	....	....	....	21.20	....	....	....	....	Cal. Dept. Agr., Spec. Pub. 51, 43 (1925).
Parke, Davis & Co., Detroit, Mich. Kreso Dip No. 1.....	....	22.55	....	20.80	8.00	8.60	2.65	....	44.60	....	Cal. Dept. Agr., Spec. Pub. 75, 59 (1927).

Polk Miller Products Corp. Sergeant's Disinfectant	....	22.10	....	23.00	10.00	9.00	0.70	....	42.60	....	Cal. Dept. Agr., Spec. Pub. 75, 59 (1927).
Pratt Food Co. Pratt's Dip and Disinfectant	9.50	9.20	....	15.50	10.00	8.00	0.30	....	64.90[11]	....	Cal. Dept. Agr., Spec. Pub. 75, 59 (1927).
W. T. Rawleigh Co., Oakland, Cal. Rawleigh's Stock Dip and Disfectant	....	16.40	....	17.90	8.00	8.40	1.20	....	54.30	....	Cal. Dept. Agr., Spec. Pub. 75, 59 (1927).
Ansel W. Robinson, San Francisco, Cal. Robinson's Red Label Sheep Dip	....	20.12	....	9.41	10.00	2.00	0.07	....	65.40	....	Cal. Dept. Agr., Spec. Pub. 75, 59 (1927).
R. R. Rogers Chemical Co., San Francisco, Cal. Arcol	50.00	51.85	20.00	19.78	25.00	22.25	0.09	....	5.34	....	Cal. Dept. Agr., Spec. Pub. 75, 59 (1927).
R. R. Rogers Chemical Co., San Francisco, Cal. Ravol	50.00	43.50	20.00	21.50	27.00	24.01	0.63	....	8.40	....	Cal. Dept. Agr., Spec. Pub. 75, 59 (1927).
R. R. Rogers Chemical Co., San Francisco, Cal. Vermol	50.00	50.50	20.00	22.80	25.00	19.90	0.68	....	4.79	....	Cal. Dept. Agr., Spec. Pub. 75, 59 (1927).
Scott & Gilbert Co. Scott & Gilbert Sheep Dip	....	19.20	....	18.45	10.00	9.10	0.80	....	51.45	....	Cal. Dept. Agr., Spec. Pub. 75, 59 (1927).
The Shaw-Batcher Co. Capital Sheep Dip and Cattle Wash[12]	....	....	....	....	....	....	....	....	....	....	Cal. Dept. Agr., Spec. Pub. 75, 59 (1927).
The Sherwin-Williams Co., Cleveland, Ohio. Pheno Dip	....	26.50	....	23.90	8.00	8.20	0.30	....	38.80	....	Cal. Dept. Agr., Spec. Pub. 75, 60 (1927).
The Sherwin-Williams Co., Cleveland, Ohio. Phenolene[1]	....	15.20	....	21.10	10.00	8.40	0.23	54.31	....	....	Cal. Dept. Agr., Spec. Pub. 51, 45 (1925).
The Sherwin-Williams Co., Cleveland, Ohio. S. W. Sheep Dip	....	10.40	....	22.10	10.00	10.00	0.10	....	55.30	....	Cal. Dept. Agr., Spec. Pub. 75, 60 (1927).
Spratt's Patent, Ltd., San Francisco, Cal. Spratt's Dip	....	23.70	....	20.80	10.00	8.00	2.90	....	43.80	....	Cal. Dept. Agr., Spec. Pub. 75, 60 (1927).
United Drug Co. No. 6 Disinfectant	....	29.40	....	14.70	10.00	7.80	2.20	....	45.40	....	Cal. Dept. Agr., Spec. Pub. 75, 60 (1927).

[1]Contains rosin.
[8]Sp. Gr. of oil, Baumé, 3.70. Unsulphonated, trace.
[9]Substance is a creosote soap emulsion.
[10]Sp. Gr. of oil, Baumé, 22.40. Unsulphonated, 39.90 per cent.
[11]Guaranteed 55.00 per cent.
[12]Emulsion broken. Not analyzed.

TABLE XXVI. PHENOL SOAP SOLUTIONS—*Concluded.*

Manufacturer or Distributor and Brand	Phenols		Soap		Water		Non-Soap Ash	Oils			Publication
	Guaranteed	Found	Guaranteed	Found	Guaranteed	Found		Total	Tar	Mineral	
	%	%	%	%	%	%	%	%	%	%	
Geo. Z. Wait Co. Dr. G. Z. Wait's Sheep Dip	15.00	13.70	....	21.40	....	10.20	....	0.10	52.20[11]	....	Cal. Dept. Agr., Spec. Pub. 75, 60 (1927).
G. Z. Waite, Sacramento, Cal. Sheep Dip	15.00	14.20	....	21.20	....	9.60	....	51.10[7]	....	....	Cal. Dept. Agr., Spec. Pub. 58, 46 (1925).
Water Bros., Inc., Oakland, Cal. Liquor Cresolis Compound	40.00	45.50	....	34.10[13]	28.00	17.00	0.50	....	1.80	....	Cal. Dept. Agr., Spec. Pub. 75, 60 (1927).
Water Bros., Inc., Oakland, Cal. Sheep Dip	....	21.40	....	6.90	10.00	3.20	0.20	....	28.10	....	Cal. Dept. Agr., Spec. Pub. 75, 60 (1927).
J. R. Watkins Co., Oakland, Cal. Watkin's Germicide Dip and Disinfectant	18.00	17.40	24.40	22.70	....	8.40	1.40	....	49.00[14]	....	Cal. Dept. Agr., Spec. Pub. 75, 60 (1927).
West Disinfecting Co., San Francisco, Cal. Carco Natholeum Dip	....	12.50	....	21.80	10.00	10.40	1.80	....	51.60	....	Cal. Dept. Agr., Spec. Pub. 75, 60 (1927).
West Disinfecting Co. Karspray	....	47.00	....	21.40	25.00	21.40	....	3.65	....	....	Cal. Dept. Agr., Spec. Pub. 66, 33 (1926).
West Disinfecting Co. Licresolis	....	55.63	....	....	15.00	13.20	....	....	....	....	Cal. Dept. Agr., Spec. Pub. 51, 43 (1925).
Western Wholesale Drug Co., Los Angeles, Cal. Solution of Cresol	50.00	48.30	....	....	....	19.20	....	....	....	....	Cal. Dept. Agr., Spec. Pub. 51, 43 (1925).
Williams & Moore. W. & M. Antiseptic Sheep Dip	....	18.10	....	....	15.00	8.00	....	....	....	....	Cal. Dept. Agr., Spec. Pub. 51, 44 (1925).

[7]Sp. Gr. of oil, Baumé, 2.95. Unsulphonated, 1.80 per cent.
[11]Guaranteed 55.00 per cent.
[13]Includes 32.00 per cent. olive and other oils.
[14]Guaranteed 49.30 per cent.

TABLE XXVII. PHOSPHORUS PREPARATIONS

Manufacturer or Distributor and Brand	Free Phosphorus		Publication
	Guaranteed	Found	
	%	%	
Ann-Pfeiffer Chemical Co., St. Louis, Mo. Allan's Lightning Roach Paste[1]	....	1.94	U. S. D. A. Bur. Chem., Bull. 68, 45 (1902).
American Druggists Syndicate. A.D. Rat and Roach Paste	2.00	1.90	Cal. Dept. Agr., Spec. Pub. 75, 47 (1927).
Bernard & Co., Boston, Mass. Roach and Water Bug Exterminator[2]	....	1.37	U. S. D. A. Bur. Chem., Bull. 68, 45 (1902).
C. S. Brown & Co., Chicago, Ill. Fidelity Cockroach Paste[3]	....	0.77	U. S. D. A. Bur. Chem., Bull. 68, 45 (1902).
Buffalo Specialty Co. Rat Nip	2.50	1.20	Cal. Dept. Agr., Spec. Pub. 75, 47 (1927).
B. E. Cole, Hollister, Cal. Squirrel poison-Phosphorus[4]	0.90	0.026	Cal. Dept. Agr., Spec. Pub. 51, 52 (1925).
Common Sense Mfg. Co. Common Sense Rat Exterminator	2.00	1.59	Cal. Dept. Agr., Spec. Pub. 58, 41 (1925).
T. DePree Co., San Francisco, Cal. Pied Piper Rat and Roach Paste	2.00	1.30	Cal. Dept. Agr., Spec. Pub. 75, 47 (1927).
C. V. Hill Chemical Co., Los Angeles, Cal. Rat Poison (Mission)[5]	....	0.60	Cal. Dept. Agr., Spec. Pub. 51, 52,(1925).
Hielson & Damrell, Modesto, Cal. Gold Crown Poison	5.00	8.53	Cal. Dept. Agr., Spec. Pub. 75, 47 (1927).
Hielson & Damrell, Modesto, Cal. Gold Crown Poison Barley[6]	....	0.07	Cal. Dept. Agr., Spec. Pub. 66, 35 (1926).
Jacob's Pharmacy, Atlanta, Ga. Tiger Paste[2]	....	1.93	U. S. D. A. Bur. Chem., Bull. 68, 45 (1902).
H. K. Mulford Co. Mulford Phosphorus Paste	2.00	2.34	Cal. Dept. Agr., Spec. Pub. 75, 47 (1927).
Nel Co., San Francisco, Cal. Sure Kill Rat and Roach Paste	1.50	1.58	Cal. Dept. Agr., Spec. Pub. 75, 47 (1927).
The Rat Biscuit Co. Rat Bis-Kit Paste	2.00	2.28	Cal. Dept. Agr., Spec. Pub. 75, 47 (1927).
The Rat-Mum Co. Rat-Mum	0.20	0.11	Cal. Dept. Agr., Spec. Pub. 58, 41 (1925).
Stearns' Electric Paste Co. Stearns' Electric Rat and Roach Paste	1.50	2.16	Cal. Dept. Agr., Spec. Pub. 75, 47 (1927).
Sued Drug Co. Elkay's Rat and Roach Paste	2.00	1.73	Cal. Dept. Agr., Spec. Pub. 75, 47 (1927).
Swell's Exterminating Co., Westfield, N. J. Youell's Rat Snap[7]	3–1 7/16	0.63	Cal. Dept. Agr., Spec. Pub. 51, 52 (1925).
Zeno Products, Inc., New York, N. Y. Zeno	2.00	0.11	Cal. Dept. Agr., Spec. Pub. 51, 52 (1925).

[1]Contains corn starch and glucose.
[2]Contains wheat starch and molasses.
[3]Contains wheat starch, molasses and glucose.
[4]Manufacture discontinued.
[5]Guaranteed 97.00 per cent. inert matter (honey). Manufacture discontinued.
[6]No potassium cyanide found present.
[7]Guaranteed hydrocyanic acid 5/16 per cent; hydrochloric acid 5/16 per cent; hydrofluoric acid 5/16 per cent; "vertigrese," blue stone and water 1 4/16 per cent; molasses, flour and corn meal 94 1/16 per cent. No hydrocyanic, hydrochloric or hydrofluoric acids or copper found.

Phenol Soap Solutions.

See Table XXVI.

Phosphorus Preparations.

See Table XXVII.

Pied Piper Rat and Roach Paste.

See "Phosphorus Preparations."

Pink Arsenoid (Lead Arsenite.)

(ADLER COLOR & CHEMICAL WORKS, NEW YORK, N. Y.)

Found: Lead oxide 49.58 per cent; combined arsenious oxide 40.02 per cent; free arsenious oxide 3.24 per cent; moisture 0.31 per cent; organic matter, lead sulphate, etc., 6.85 per cent. The substance is colored with a pink aniline residue.

Univ. of Cal. Coll. of Agr. Expt. Sta., Bull. 151, 26 (1903).

P. K. B.

(JOHN LUCAS & CO., INC., PHILADELPHIA, PA.)

	Guaranteed.	Found.
Total arsenic, metal	21.00	21.64
Water-soluble arsenic, metal	1.00	0.87
Copper	....	15.50

N. J. Agr. Expt. Sta., Bull. 441, 13 (1926).

Plant Oil.

(B. G. PRATT CO., NEW YORK, N. Y.)

Found: Largely vegetable oils.

N. Y. Agr. Expt. Sta,. Bull. 384, 302 (1914).

Plant Tonic and Insecticide.

(BYRNE MFG. CO., OAKLAND, CAL.)

Declared composition: Tobacco stems, lime, sulfur, borax, oil of sassafras (synthetic), geranium oil and water.

Found: Nicotine 0.22 per cent; free sulphur 0.39 per cent; faint test for borax; very small amount of calcium oxide; sassafras and geranium oils present.

Cal. Dept. Agr., Spec. Pub. 34, 60 (1923).

Poison Bait Compound.

(CHIPMAN CHEMICAL ENGINEERING CO., INC., NEW YORK, N. Y.)

Guaranteed: Sodium arsenite 2.50 per cent; inert matter 97.50 per cent; total arsenic 1.60 per cent; water-soluble arsenic 1.60 per cent.

Found: Total arsenic (metal), 0.98 per cent.

Conn. Agr. Expt. Sta., Sample 1825.

Poison Barley.

See "Strychnine Preparations."

Poisoned Ant Syrup.

(SAN DIEGO HORTICULTURAL COMMISSIONER, SAN DIEGO, CAL.)

	Guaranteed.	Found.
Sodium arsenite	0.15	0.23

Cal. Dept. Agr., Spec. Pub. 66, 19 (1926).

Poisoned Barley.

Poisoned Grain.

Poisoned Grain Squirrel Poison.

See "Strychnine Preparations".

Poison Green.

(BANNENMAN CHEMICAL CO., SYRACUSE, N. Y.)

Found: Substance is artifically colored calcium arsenite. Arsenious oxide, 38.4 per cent.

N. Y. Agr. Expt. Sta., Bull. 348, 98 (1912).

Poison Spray Tabs—Bordeaux Arsenate.

(EARL THOMAS CULTURE CORP, NEW YORK, N.Y.)

	Guaranteed.	Found.
Total arsenic, metal	5.00	5.51
Water-soluble arsenic, metal	0.05	0.07
Copper	....	12.40

Maine Agr. Expt. Sta., Official Inspections 110, 56 (1923).

Poison Wheat.

See "Strychnine Preparations."

Pomodust.

See "Niagara 90-10 Dusting Mixture."

Potassium Cyanide.

(MANUFACTURER NOT STATED).

Found: Moisture 0.22 per cent; potassium cyanide 93.80 per cent sodium cyanide 0.87 per cent; sodium chloride 1.15 per cent; potassium ferrocyanide 0.75 per cent; fine dust 3.22 per cent.

Cal. Dept. Agr., Spec. Pub. 34, 25 (1923).

Potato Dust Mixture.

See "Nicotine Dusts."

Potato Dust Poison.

(DELORO CHEMICAL CO., DELORO, ONT., CANADA).

Found: Total arsenic oxide 9.62 per cent; water-soluble arsenic oxide 0.10 per cent; cupric oxide 8.07 per cent.

Canada Dept. Agr., Div. Chem., Rept. Dominion Chemist (1928).

Potato Scab Destroyer.

(AM. HORT. DISTRIBUTING CO., MARTINSBURG, W. VA.)

Found: Substance is an artifically colored solution of formaldehyde.

N. Y. Agr. Expt. Sta., Bull. 384, 301 (1914).

Poultry House Spray.

(PURITY CHEMICAL PRODUCTS CO., SANTA ROSA, CAL.)

Guaranteed: Phenols 25.00 per cent; base, sediment and moisture 2.00 per cent.

Found: Phenols 25.00 per cent; mineral oils 53.90 per cent; water 0.40 per cent.

Cal. Dept. Agr., Spec. Pub. 75, 56 (1927).

Pratt's Carboleine.

See "Oil Emulsions, Mineral."

Pratt's Dip & Disinfectant.

See "Phenol Soap Solutions."

Pratt's Lice Killer.

(PRATT FOOD CO.)

	Guaranteed.	Found.
Nicotine	0.34	0.72
Naphthalene	5.60	5.88
Pyrethrum	4.00	....

Cal. Dept. Agr. Spec. Pub. 75, 40 (1927).

Premium Intestinal Cleaner.

(GERMAIN SEED & PLANT CO., LOS ANGELES, CAL.)

	Guaranteed.	Found.
Sodium bicarbonate	15.00	15.84

Cal. Dept. Agr., Spec. Pub. 75, 65 (1927).

Preparation B.

(THE INSECTICIDE CO., SAN FRANCISCO, CAL.)

Guaranteed: Inert matter, trace of butter color.
Found: Mineral oils 10.00 per cent; yellow color present; no ash.

Cal. Dept Agr., Spec. Pub. 51, 60 (1925).

Preparation No. 3

(THE INSECTICIDE CO., SAN FRANCISCO, CAL.)

See "Sodium Fluoride."

Preparation No. 5.[1]

(THE INSECTICIDE CO., SAN FRANCISCO, CAL.)

	Guaranteed.	Found.	Guaranteed.	Found.
Calcium arsenate	7.00	3.48	3.25	3.80
Calcium arsenite	1.00	2.83	2.50	2.71

Cal. Dept. Agr., Spec. Pub. 75, 26 (1927).

Prussic Acid.

See "Hydrocyanic Acid."

P. S. C. Condensed Rosin Spray.

P. S. C. Fish Oil Soap.

See "Soap."

Puritol.

See "Albatross Puritol."

Purity.

(PURITY CHEMICAL PRODUCTS CO.)

	Guaranteed.	Found.
Sodium hypochlorite	4.00	4.24
Available chlorine	....	4.04

Cal. Dept. Agr., Spec. Pub. 75, 61 (1927).

Pyrethro Fly Fluid.

(W. T. RAWLEIGH CO., FREEPORT, ILL.)

Not analyzed.

Cal. Dept. Agr., Spec. Pub. 58, 48 (1925).

[1] Two grades.

Pyrethrum

See Table XXVIII.

Pyrox.

See "Bordeaux Mixture-Lead Arsenate."

Q.

Qua-Sul.[1]

(A. R. GREGORY, SAN FRANCISO, CAL.)

	Guar.	Found.	Guar.	Found.	Guar.	Found.
Sodium polysulphide	.....	7.04	....	8.00	4.45	7.24
Sodium thiosulphate	.....	3.04	....	3.17	7.16	3.60
Active sulphur	.....	.....	6.00	....	....	....
Baumé gravity	.....	19.00	....	20.50	....	19.00

Cal. Dept. Agr. Spec. Pub. 66, 23 (1926).

Quick Action Fly Killer.

(QUICK ACTION PRODUCTS CO., BELL, CAL.)

	Guaranteed.	Found.
Baumé gravity, 15.5°C	....	39.90
Mineral oil	....	96.74
Methyl salicylate	3.00	2.49

Cal. Dept. Agr., Spec. Pub. 51, 55 (1925).

Quick Action Lice Powder.

(QUICK ACTION PRODUCTS CO., LOS ANGELES, CAL.)

	Guaranteed.	Found.
Cresol oil (Phenols)	1.00	0.05
Hydrocarbons	10.00	....
Naphthalene	....	5.92
Sodium fluoride	10.00	8.20
Inert matter	79.00	....

Cal. Dept. Agr., Spec. Pub. 51, 59 (1925).

Qykade.

(THE CHLORINE PRODUCTS CO., NEW YORK, N. Y.)

Found: Grams per 100 cc. total solids 1.26; available chlorine 0.40; total chlorine, 0.71; calcium oxide, 0.64 per cent. Substance is a mixture of calcium hypochlorite and calcium chloride in solution.

Conn. Agr. Expt. Sta., Bull. 258, 376 (1924).

R.

Rajah Argentine Ant Poison.

(THE OWL DRUG CO., SAN FRANCISCO, CAL.)

	Guaranteed.	Found.
Total arsenic, metal	0.20	0.16
Water-soluble arsenic, metal	0.20	0.16

Cal. Dept. Agr., Spec. Pub. 34, 18 (1923).

Rat Bis-Kit Paste.

See "Phosphorus Preparations."

[1] Three Samples.

TABLE XXVIII. PYRETHRUM

Manufacturer or Distributor and Brand	Ether Extract	Ash	Water	Publication
	%	%	%	
Buhack Producing & Mfg. Co. Buhack Insect Powder	6.80	6.43	.....	Cal Dept. Agr., Spe . Pub. 75, 63 (1927).
W. T Rawleigh Co., Oakland, Ca'. Rawleigh's Insect Powder	9.00	6.80	.....	Cal. Dept. Ag ., Spec. Pub. 75 63 (1927).
Winkelmann & Brown Drug Co., Baltimore, Md. Death Dust for Insects	10.68	7.74	6.75	U. S. D. A , Bur. Chem., Bull. 68 39 (1902).

Rat-Ex.

(CHEMICAL SPECIALTIES CO., LOS ANGELES, CAL.)

	Guaranteed.	Found.
Barium carbonate	20.00	26.21
Inert matter	80.00	....

Cal. Dept. Agr., Spec. Pub. 66, 34 (1926).

Rat-Go.

See "Leinen."

Rat-Mum.

Rat-Nip.

Rat Poison (Mission).

See "Phosphorus Preparations".

Rat Scent.

See "Strychnine Preparations".

Rat Tex.

(CALIFORNIA REX SPRAY CO., WATSONVILLE, CAL.)

	Guaranteed.	Found.
Arsenious oxide	30.00	31.66

Cal. Dept. Agr., Spec. Pub. 75, 26 (1927).

Ravol.

See "Phenol Soap Solutions."

Rawleigh's Insect Powder.

See "Pyrethrum."

Rawleigh's Louse Powder.

(W. T. RAWLEIGH CO., FREEPORT, ILL.)

Not analyzed.

Cal. Dept. Agr., Spec. Pub. 58, 48 (1925).

Rawleigh's Stock Dip & Disinfectant.

See "Phenol Soap Solutions."

Red Cross Ant Destroyer.

(RED CROSS CHEMICAL CO., CINCINNATI, OHIO.)

Found: Borax 11.07 per cent; calcium oxide 13.12 per cent; sulphur trioxide 18.56 per cent; gypsum and sassafras root present.

U. S. D. A., Bur. Chem., Bull. 68, 43 (1902).

Red Label Sheep Dip.

See "Phenol Soap Solutions."

Reliance Argentine Ant Poison.

(LANGLEY & MICHAELS CO., SAN FRANCISCO, CAL.)

Guaranteed: Arsenic, metal 0.11 per cent; sodium arsenite 0.20 per cent.

Found: Arsenic, metal 0.13 per cent; sodium arsenite 0.22 per cent; invert sugar 7.88 per cent; cane sugar 40.29 per cent; dextrin, etc., 1.82 per cent; water 47.67 per cent.

Cal. Dept. Agr., Spec. Pub. 58, 16 (1925).

Renol.

See "Oil Emulsions, Mineral."

Revenge Lice Destroyer.

(I. D. RUSSELL CO.)

	Guaranteed.	Found.
Naphthalene	2.00	3.57
Sulphur	5.00	5.35
Phenols	....	0.80
Phenol and creosote	5.00	5.92

Cal. Dept. Agr. Spec. Pub. 75, 41 (1927).

Rex Emulso.

See "Oil Emulsions, Mineral.":

Rex Fly Tox.

(CALIFORNIA REX SPRAY CO., BENICIA, CAL.)

Guaranteed: Active ingredients 100.00 per cent.

Found: Specific gravity, 0.8147; oil 100.00 per cent; no water or ash; kerosene 92.50 per cent; safrole present.

Cal. Dept. Agr., Spec. Pub. 51, 56 (1925).

Rex Miscible Oil.

Rex Vulture Oil.

See "Oil Emulsions, Mineral."

Rid-O-Germ.

(WESTERN CHEMICAL CO., INC.)

	Guaranteed.	Found.
Available chlorine	....	2.68
Water	87.28	87.45

Cal. Dept. Agr., Spec. Pub. 75, 61 (1927).

Rip Van Winkle Fly Spray.

See "Oils, Mineral."

Roach and Croton Bug Exterminator.

(PERFECTION MFG. CO., JERSEY CITY, N. J.)

Found: Borax 47.61 per cent; balance pyrethrum, corn meal and pink coloring matter.

U. S. D. A., Bur. Chem., Bull. 68, 43 (1902).

Roach and Water Bug Exterminator.

See "Phosphorus Preparations."

Roach Doom.

See "Murray."

Roachine.

(BROWN & ALLEN, ATLANTA, GA.)

Found: Borax 90.00 per cent; balance pyrethrum and blue coloring matter.

U. S. D. A., Bur. Chem., Bull. 68, 43 (1902).

Roach Liquid.

(THE PIED PIPER SERVICE, PROVIDENCE, R. I.)

Found: Substance is a mixture of kerosene and methyl salicylate.

Conn. Agr. Expt. Sta., Bull. 258, 376 (1924).

Roach Powder.

(THE PIED PIPER SERVICE, PROVIDENCE, R. I.)

Found: Water 14.57 per cent; nitrogen 0.50 per cent; protein 3.13 per cent; starch 13.73 per cent; ash 40.60 per cent; sodium oxide 18.89 per cent; boric oxide 18.32 per cent; chloride 5.12 per cent; traces of silica, iron, sulphate and phosphate. The substance is a mixture of a cereal, borax and salt.

Conn. Agr. Expt. Sta., Bull. 258, 376 (1924).

Roachsault.

(BARRETT CHEMICAL CO., NEW YORK, N. Y.)

Found: Sodium fluoride 85.00 per cent; water 2.53 per cent; aluminum and iron oxides 0.27 per cent; fine sand 9.60 per cent; sodium sulphate (by difference), 2.60 per cent.

U. S. D. A., Bur. Chem., Bull. 68, 53 (1902).

Rosin Spray.

See "Soaps."

Rough on Rats.

(E. S. WELLS ESTATE.)

	Guaranteed.	Found.
Arsenious oxide	....	98.19
Arsenic, metal	56.00	74.37
Barium carbonate	20.00	0.00

Cal. Dept. Agr., Spec. Pub. 75, 27 (1927).

Royal Roach Powder.

(H. C. DUBRING & CO., CHICAGO, ILL.)

Found: Borax 30.94 per cent; arsenious oxide 0.73 per cent; arsenic oxide 4.69 per cent; some calcium and dye stuff. Substance is probably a mixture of borax, London Purple and pyrethrum.

U. S. D. A., Bur. Chem., Bull. 68, 30 (1902).

S.

Salairacine.

(J. D. MCGREGOR, STAMFORD, CONN.)

Two Samples:

Sample 17745.

Found: Moisture 0.90 per cent; acid-insoluble matter, 0.56 per cent; nitrate nitrogen none; lead oxide 24.21 per cent; arsenic oxide 11.73 per cent; iron and aluminum oxides 0.50 per cent; calcium oxide 25.64 per per cent; magnesium oxide 17.33 per cent; carbon dioxide (by difference) 19.13 per cent.

Sample 19740.

Found: Nitrate nitrogen 1.95 per cent; arsenic oxide 10.54 per cent; calcium oxide 17.67 per cen .

Conn. Agr. Expt. Sta., Bull. 242, 161 (1922).

Sanders Blue Dust 5-11.

(NEW YORK INSECTICIDE CO., MEDINA, N. Y.)

	Guaranteed.	Found.
Copper	9.00	11.10

Maine Agr. Expt. Sta., Official Inspections 122, 86 (1926).

Sander's Dust.

(MANUFACTURER UNKNOWN).

Found: Copper 6.10 per cent; arsenic 2.93 per cent; Arsenic is present as calcium arsenate.

Conn. Agr. Expt. Sta., Bull. 258, 370 (1925).

San Jose Summer Oil.

See "Oil Emulsions, Mineral."

San-U-Zay Scale Oil.

(THE GARDINER-JOHNS CO., ROCHESTER, N. Y.)

Found: The substance is largely a mixture of mineral and animal oils.

N. Y. Agr. Expt. Sta., Bull. 384, 301 (1914).

Sapho "Fly X."

(THE KENNEDY MFG. CO., MONTREAL, CANADA.)

Found: Specific gravity, 19° C., 0.844; flash point 67° C.; fire point 77° C.; residue at 100° C., 0.15 per cent; methyl salicylate 2.08 per cent. Base is kerosene.

Canada Dept. Agr., Div. Chem., Rept. Dominion Chemist (1928).

Sapho Liquid.

(THE KENNEDY MFG. CO., MONTREAL, CANADA).

Found: Specific gravity, 19° C., 0.844; flash point 67° C.; fire point 78° C.; residue at 100° C., 0.81 per cent; phenol 1.68 per cent. Base is kerosene.

Canada Dept. Agr., Div. Chem., Rept. Dominion Chemist (1928).

Sarpa Poultry Spray.

See "Oil Emulsions, Mineral."

Scalecide.

(B. G. PRATT CO., NEW YORK, N. Y.)

Found: Substance is a mixture of mineral and vegetable oils and naphthalene.

N. Y. Agr. Expt. Sta., Bull. 384, 302 (1914).

Scalybark Insecticide.

(DR. MESSIG, SANTA ANA, CAL.)

Found: Water 82.92 per cent; solids 17.08 per cent; lime-sulphur 3.00 per cent; sodium chloride 3.50 per cent; soap 3.00 per cent; free sulphur and vegetable matter, etc. 4.30 per cent; no lead; a minute quantity of arsenic. The substance is partly a yellow liquid and partly a black solid containing some small leaves; it has an ammoniacal odor.

Cal. Dept. Agr., Spec. Pub. 34, 57 (1923).

Schnarr's Insecticide.

See "Oil Emulsions, Mineral."

Schrader Argentine Ant Powder.

(SCHRADER CHEMICAL CO., SAN FRANCISCO, CAL.)

Guaranteed: Sodium fluoride 68.00 per cent; sodium acid fluoride 8.00 per cent; all closed dalmatian flowers 7.20 per cent.

Found: Total fluorine 38.33 per cent.

Cal. Dept. Agr., Spec. Pub. 75, 63 (1927).

Schrader's Argentine Ant Syrup.

(SCHRADER CHEMICAL CO., SAN FRANCISCO, CAL.)

	Guaranteed.	Found.
Arsenious oxide	0.20	0.20

Cal. Dept. Agr., Spec. Pub. 75, 24 (1927).

Schrader's Red Ant Powder.

(SCHRADER INSECT POWDERS CO., SAN FRANCISCO, CAL.)

Guaranteed: Sodium fluoride 55.00 per cent; sodium acid fluoride 10.00 per cent; all closed dalmatian flowers 20.00 per cent; inert matter 15.00 per cent.

Found: Total fluorine 30.14 per cent; organic matter 21.13 per cent.

Cal. Dept. Agr., Spec. Pub. 66, 37 (1926).

Scott & Gilbert Sheep Dip.

See "Phenol Soap Solutions."

Scrofularia.

(BENJ. HAMMOND, FISHKILL-ON-HUDSON, N. Y.)

Found: Moisture 4.91 per cent; ash 19.52 per cent; ether extract 7.35 per cent. Substance is a mixture of tobacco and pyrethrum colored with lead chromate.

U. S. D. A., Bur. Chem., Bull. 68, 49 (1902).

Selenine.

(CHARLES DICKENS, OAKLAND, CAL.)

Found: Barium polysulphide 4.33 per cent; barium thiosulphate 0.39 per cent; selenium 0.23 per cent; tellurium trace.

Cal. Dept. Agr., Spec. Pub. 58, 50 (1925).

Semesan.

(E. I. DUPONT DE NEMOURS & CO., INC., WILMINGTON, DEL.).

Guaranteed: Hydroxymercurichlorphenol 35 per cent.; inert matter 65.00 per cent.

Found: Mercury 21.32 per cent; hydroxymercurichlorphenol 36.68 per cent; ash 66.30 per cent; calcium oxide 16.72 per cent; silica 0.68 per cent; iron and aluminum oxides 0.35 per cent; magnesium oxide 0.35 per cent; carbon dioxide 16.79 per cent. The mercury compound is para-hydroxymercuri-orthochlorphenol, probably present as the sodium salt. The inert matter is probably a mixture of calcium hydroxide and sodium carbonate.

Conn. Agr. Expt. Sta., Sample 8932.

Semesan Bel.

(E. I. DUPONT DE NEMOURS & CO., INC., WILMINGTON, DEL.).

Guaranteed: Hydroxymercurichlorphenol 10.00 per cent.

Found: Mercury 6.52 per cent.

Cal. Dept. Agr. Spec. Pub. 75, 62 (1927).

Sergeant's Disinfectant.

See "Phenol Soap Solutions."

70-10-20.

(J. R. GILLAM & BRO., BURLINGTON, N. J.)

	Guaranteed.	Found.
Total arsenic, metal	1.80	1.80
Water-soluble arsenic, metal	....	0.30
Sulphur	68.00	69.69

N. J. Agr. Expt. Sta., Bull. 441, 11 (1926).

70-10-20 Mixture.

See "Niagara Mixture No. 150."

70-10-20 Sulfur Lead-Lime Dust.

(LUCAS-KIL-TONE CO., VINELAND, N. J.)

Guaranteed: Sulphur 70.00 per cent.

Found: Sulphur 66.48 per cent; total arsenic 1.93 per cent; water-soluble arsenic 0.26 per cent.

N. J. Agr. Expt. Sta., Bull. 459, 11 (1927).

70-20-10 Dusting Mixture.

(MECHLING BROS. CHEMICAL CO., CAMDEN, N. J.)

	Guaranteed.	Found.
Total arsenic, metal	2.00	2.65
Water-soluble arsenic, metal	0.50	0.12
Sulphur	69.00	65.47

N. J. Agr. Expt. Sta., Bull. 459, 12 (1927).

75-5-20

(J. R. GILLAM & BRO., BURLINGTON, N. J.)

Found: Total arsenic 1.28 per cent; water-soluble arsenic 0.26 per cent; sulphur 72.00 per cent.

N. J. Agr. Expt. Sta., Bull. 441, 11 (1926).

S & G Poultry Lice Powder.

See "Sodium fluoride."

Sheep Dip.

See "Phenol Soap Solutions."

Simplex.

(H. G. SMITH CO., UTICA, N. Y.)

	Guaranteed.	Found.
Sulphur	20.00	21.07
Arsenic	....	2.61
Lead oxide	....	9.75

Mich. Agr. Coll. Expt. Sta., Spec. Bull. 74, 11 (1915).

Sin-O-lor.

(HUGH KNIGHT, RIVERSIDE, CAL.)

Found: Substance is a purple liquid containing nearly 1 per cent potassium permanganate and 0.62 per cent sodium sulphate.

Cal. Dept. Agr., Spec. Pub. 34, 58 (1923).

S. J. Nicotine Dust.

See "Nicotine Dusts."

Skalene.

Skalol.

See "Oil Emulsions, Mineral."

Skinner's Arsenate Bordeaux.

See "Bordeaux Mixture-Lead Arsenate."

Skinner's Special 30-70 Copper Lime Dust.

(SKINNER MACHINERY CO., DUNEDIN, FLA.)

	Guaranteed.	Found.
Copper	10.00	12.11

N. J. Agr. Expt. Sta., Bull. 407, 16 (1924).

Slugall.

(GERMAIN SEED & PLANT CO., LOS ANGELES, CAL.)

	Guaranteed.	Found.
Nicotine	0.10	0.12
Total arsenious oxide	1.00	0.37
Water-soluble arsenious oxide	0.63	0.25
Naphthalene	5.00	1.10

Cal. Dept. Agr., Spec. Pub. 75, 38 (1927).

Slug Shot.

(HAMMOND'S SLUG SHOT WORKS, BEACON, N. Y.)

	Guaranteed.	Found.
Free sulphur	6.00	....
Total arsenic, metal	0.79	0.89
Water-soluble arsenic, metal	trace	0.12
Copper	0.91	1.01
Nicotine	trace	0.04
Crude carbolic acid	0.40	present

Copper sulphate and copper arsenate declared present.

Conn. Agr. Expt. Sta., Bull. 242, 159 (1922).

Slug Slugger.

(MICHEL & PELTON CO.)

	Guaranteed.	Found.
Calcium arsenate	3.00	4.76

Cal. Dept. Agr., Spec. Pub. 75, 27 (1927).

Small's Snail Poison.

(SMALL'S SEED CO., RIVERSIDE, CAL.)

	Guaranteed.	Found.
Calcium arsenate	2.80	3.80

Cal. Dept. Agr., Spec. Pub. 75, 27 (1927).

Snailex.

(THE FERTILSPRAY CO., LOS ANGELES, CAL.)

	Guaranteed.	Found.
Ferrous sulphate	20.00	20.06
Ferric sulphate	20.00	32.39
Copper sulphate	0.45	1.25

Cal. Dept. Agr., Spec. Pub. 75, 45 (1927).

Snail Foil.

(AN-FO MFG. CO.)

	Guaranteed.	Found.
Free sulphur	3.00	2.88
Phenols	2.00	2.28
Sodium fluoride	1.00	1.36
Mineral oil	8.00	8.77

Cal. Dept. Agr., Spec. Pub. 75, 40 (1927).

Snail Poison.

See "Small's Snail Poison."

Snarol.

(THE ANTROL LABORATORIES, INC., LOS ANGELES, CAL.)

	Guaranteed.	Found.
Calcium arsenate	3.50	5.17
Total arsenic, metal	1.32	1.95
Inert matter	96.50	....

Conn. Agr. Expt. Sta., Sample 8935.

Soap.

See Table XXIX.

Soap, Sulfo-Tobacco Plant & Animal.

See "Nicotine Soaps."

Soap, Sulpho-Tobacco.

See "Sulpho-Tobacco Soap."

Soap, Tobacco.

See "Nicotine Soaps."

Soda-Sulfur Compound.

(W. C. COLLINS, SAN FRANCISCO, CAL.)

Found: Water-soluble matter, 68.44 per cent; sodium polysulphide 0.80 per cent.

Cal. Dept. Agr., Spec. Pub. 34, 32 (1923).

Sodium Fluoride.

See Table XXX.

Sodium Fluosilicate.

(VIRGINIA-CAROLINA CHEMICAL CORP., RICHMOND, VA.)

Found: Sodium fluosilicate 79.39 per cent; sodium fluoride 16.45 per cent; sodium carbonate 0.75 per cent; undetermined 3.41 per cent.

Conn. Agr. Expt. Sta., Sample 7505.

Solbar.

See "Barium Tetrasulphide."

Sol-o-cree.

See "Phenol Soap Solutions."

Soluble Arsenoid.

See "Watson."

Soluble Oil.

Soluble Oil Spray.

See "Oil Emulsions, Mineral."

Soluble Sulphur Compound.

See "Nicotine Dusts."

Soluble Sulphur Solution.[1]

(NIAGARA SPRAYER CO., MIDDLEPORT, N. Y.)

	Guaranteed.	Found.	Guaranteed.	Found.
Soluble sulphur	58.00	58.21	57.00	58.16

N. Y. Agr. Expt., Sta., Bull. 384, 296 (1924).

Solution of Cresol.

See "Phenol Soap Solutions."

S. O. S. Sterling Oil Spray.

See "Oil Emulsions, Mineral."

Sow-Bug Destroyer.

(CHAS. C. NAVLET CO., SAN FRANCISCO, CAL.).

Guaranteed: Copper aceto-arsenite 8.00 per cent.
Found: Arsenious oxide 10.94 per cent.
Cal. Dept. Agr., Spec. Pub. 75, 27 (1927).

Sow-Bug-Go.

See "Leinen."

Sow-Bug-Killer.

(SAN JOSE SPRAY MFG. CO., SAN JOSE, CAL.)

Guaranteed: Copper aceto-arsenite 8.00 per cent.
Found: Arsenious oxide 10.76 per cent.
Cal. Dept. Agr., Spec. Pub. 75, 27 (1927).

Special Dry Mix.

(THE KIL-TONE CO., VINELAND, N. J.)

Found: Sulphur 54.64 per cent.
N. J. Agr. Expt. Sta., Bull. 441, 7 (1926).

Special Filled Capsules No. 173935.

(ELI LILLY & CO., INDIANAPOLIS, IND.)

Found: Nicotine 15.82 per cent.
Cal. Dept. Agr., Spec. Pub. 66, 26 (1926).

Special Mixture 154A.

See "Nicotine-Sulphur Dusts."

Special Mixture No. 161 Potato Dust.

(NIAGARA SPRAYER CO., MIDDLEPORT, N. Y.)

	Guaranteed.	Found.
Total arsenic, metal	7.40	8.65
Water-soluble arsenic, metal	0.50	0.22
Copper	6.00	7.31

N. J. Agr. Expt. Sta., Bull. 407, 14 (1914).

Special Mixture M 163.

Special Mixture No. 221.

Special Mixture No. 274.

[1] Two Samples.

TABLE XXIX. SOAP

Manufacturer or Distributor and Brand	Soap				Water—Found	Total Alkali Found	Sodium Carbonate	Non-soap Ash	Inert Matter—Found	Publication
	Total		Rosin Soap	Fish Oil Soap						
	Guaranteed	Found								
	%	%	%	%	%	%	%	%	%	
California Pest Control Co. Calpest Whale Oil	....	24.86	....	....	69.38	2.53	....	....	....	Cal. Dept. Agr., Spec. Pub. 75, 54 (1927).
California Spray Chemical Co., Watsonville, Cal. Ortho Liquid	....	13.70	....	....	78.40[1]	....	....	1.10	....	Cal. Dept. Agr., Spec. Pub. 58, 46 (1925).
California Spray Chemical Co., Watsonville, Cal. Ortho Whale Oil	30.00	30.80	....	....	61.60	....	....	....	....	Cal. Dept. Agr., Spec. Pub. 75, 54 (1927).
Roy E. Campbell, Alhambra, Cal. Citrus Washing Powder[2]	....	20.80	....	....	35.25	....	42.40	....	....	Cal. Dept. Agr., Spec. Pub. 34, 59 (1922).
General Chemical Co., New York, N. Y. Fish Oil[3]	....	....	....	....	....	....	....	....	....	Conn Agr. Expt. Sta., Bull. 242, 160 (1922).
Germain Seed & Plant Co., Los Angeles, Cal. Germain Fish Oil[4]	....	71.20	none	71.20	....	....	....	....	23.58[5]	Cal. Dept. Agr., Spec. Pub. 51, 40 (1925).
Germain Seed & Plant Co., Los Angeles, Cal. Germain's Rosin Wash	....	34.70	6.10	28.60	....	....	....	....	63.90	Cal. Dept. Agr., Spec. Pub. 51, 40 (1925).
Johnson & Musser Seed Co., Los Angeles, Cal. J & M Reliable Insecticide[6]	....	64.71	....	....	34.30	....	....	....	....	U. S. D. A. Bur. Chem., Bull. 68, 35 (1902).
Langley & Michaels Co. Hard Fish Oil[7]	64.40	39.60	....	....	29.60[8]	....	....	....	....	Cal. Dept. Agr., Spec. Pub. 75, 54 (1927).
Manufacturer unknown. Lennox Tobacco[9]	....	....	....	....	....	....	....	....	....	Cal. Dept. Agr., Spec. Pub. 34, 47 (1922).

Michel & Pelton Co., San Francisco, Cal. Mapco Rosin Soap for Spray	....	....	43.30	18.30	....	....	7.70	....	29.10[10]	Cal. Dept. Agr., Spec. Pub. 51, 40 (1925).
Michel & Pelton Co., San Francisco, Cal. Mapco Whale Oil	....	53.30	....	....	43.40[11]	0.53	....	....	....	Cal. Dept. Agr., Spec. Pub. 75, 54 (1927).
Miller Products Co., Portland, Ore., Whale Oil	60.00	57.90	....	....	....	....	....	....	....	Ore. Agr. Expt. Sta., Cir. 84, 15 (1927).
Mt. Hood Soap Co., Portland, Ore. Felbro Whale Oil	58.50	76.10	....	....	....	....	....	....	....	Ore. Agr. Expt. Sta., Cir. 84, 15 (1927).
Chas. C. Navlet Co. Navco Whale Oil	....	25.90	....	....	69.40	....	....	....	....	Cal. Dept. Agr., Spec. Pub. 75, 54 (1927).
Pacific Soap Co. P. S. C. Condensed Rosin Spray	55.00	53.36	....	....	33.70	11.08[12]	....	....	....	Cal. Dept. Agr., Spec. Pub. 75, 54 (1927).
Pacific Soap Co. P. S. C. Condensed Rosin Spray	65.00	46.10	....	....	35.75	14.20	....	....	....	Cal. Dept. Agr., Spec. Pub. 75, 54 (1927).
Pacific Soap Co. P. S. C. Condensed Rosin Spray	....	52.00	....	....	31.74[11]	12.51	....	....	....	Cal. Dept. Agr., Spec. Pub. 75,54 (1927).
Pacific Soap Co. P. S. C. Fish Oil	75.00	76.35	....	....	16.67	4.37	....	....	....	Cal. Dept. Agr., Spec. Pub. 75, 55 (1927).
Perfecto Spray Mfg. Co., Los Angeles, Cal. Perfecto Rosin Paste	....	58.25	....	....	35.10[13]	....	....	3.99	....	Cal. Dept. Agr., Spec. Pub. 58, 46 (1925).

[1]Water guaranteed 67.00%.
[2]Trace of phosphate present.
[3]Two samples of this soap were examined only to see whether they were potassium or sodium soaps. One was a sodium soap, the other chiefly potassium soap.
[4]Glycerine 4.21 per cent.
[5]Inert matter guaranteed 30.00%.
[6]Fatty anhydrides 25.30 per cent; resin anhydrides 34.67 per cent; sodium oxide 2.92 per cent; potassium oxide 1.82 per cent.
[7]Oils 24.90 per cent.
[8]Water guaranteed 35.60%.
[9]No nicotine found.
[10]Inert matter guaranteed 30.00%.
[11]Water guaranteed 40.00%.
[12]Alkali guaranteed 10.00%.
[13]Water guaranteed 36.00%.

TABLE XXIX. SOAP—*Concluded.*

Manufacturer or Distributor and Brand	Soap				Water—Found	Total Alkali Found	Sodium Carbonate	Non-soap Ash	Inert Matter—Found	Publication
	Total		Rosin Soap	Fish Oil Soap						
	Guaranteed.	Found.								
	%	%	%	%	%	%	%	%	%	
J. C. Pierson, Albany, N. Y. Fir-Tree Oil[14]	....	66.25	....	....	28.74	7.28[15]	....	....	....	N. Y. Agr. Expt. Sta., Bull. 384, 298 (1914).
George A. Price, Albany, N. Y. Stott's Fir-Tree Oil[16]	....	71.12	....	....	23.73	5.91	....	....	....	N. Y. Agr. Expt. Sta., Bull. 348, 95 (1912).
San Jose Soap Works, San Jose, Cal. Whale Oil	....	25.90	....	....	74.10	....	....	....	....	Cal. Dept. Agr., Spec. Pub. 34, 59 (1922).
Sun-Ban Laboratories, Portland, Ore. Clensel	32.10	30.40	....	....	....	....	....	....	....	Ore. Agr. Expt. Sta., Cir. 84, 15 (1927).
J. B. Williams Co., Glastonbury, Conn. No. 30[17]	....	67.57	....	....	30.97	6.56	0.15	0.95	....	Conn. Agr. Expt. Sta., Sample 3778.
Williams & Moore, Stockton, Cal. Williams & Moore Spray	....	79.10	....	....	18.50	....	....	1.10	....	Cal. Dept. Agr., Spec. Pub. 66, 36 (1926).

[14]Fatty acids and resin 59.15 per cent; unsaponified matter (mostly phenol) 5.01 per cent.
[15]Combined alkali 7.10 per cent; free caustic 0.18 per cent.
[16]Phenol 5.15 per cent.
[17]Free oleic acid 0.63 per cent; sodium chloride 0.46 per cent.

Special 210 Dust Mixture.

See "Nicotine Dusts."

Special Mixture S 155 A.

See "Nicotine-Sulphur Dusts."

Spratt's Dip.

See "Phenol Soap Solutions."

TABLE XXX. SODIUM FLUORIDE

Manufacturer or Distributor and Brand	Sodium Fluoride		Publication
	Guaranteed	Found	
	%	%	
ıswig Drug Co.	.....	93.70	Cal. Dept. Agr., Spec. Pub. 51, 59 (1925).
·ell-Dugger Co. Talcimized	65.00	70.17	Cal. Dept. Agr., Spec. Pub. 75, 62 (1927).
Insecticide Co., San Francisco, al. Preparation No. 3[1]	.....	93.27	Cal. Dept. Agr., Spec. Pub. 75, 63 (1927).
. McClellan & Co. McClellan's	95.50	95.31	Cal. Dept. Agr., Spec. Pub. 75, 62 (1927).
·ord Chemical Co.	90.00	97.56	Cal. Dept. Agr., Spec. Pub. 75, 62 (1927).
·tgomery, Ward & Co., Port-ıd, Ore.	65.00	98.60	Ore. Agr. Expt. Sta., Cir. 84, 15 (1927).
: & Gilbert Co. S&G Poultry ·e Powder	90.00	96.58	Cal. Dept. Agr., Spec. Pub. 75, 62 (1927).

[1] sh found 5.40 per cent.; "inert fossil flour", guaranteed 7.60 per cent.

Spratt's Lice Powder.

(SPRATT'S PATENT, LTD.)

	Guaranteed.	Found.
Ash (talc)	40.00	37.06

Cal. Dept. Agr., Spec. Pub. 75, 63 (1927).

Spray Moore Weed Killer.

(KIRK, GEARY & CO.)

	Guaranteed.	Found.
Arsenious oxide	30.00	26.74

Cal. Dept. Agr., Spec. Pub. 75, 25 (1927).

Spray Mulsion.

See "Oil Emulsions, Mineral."

Squirrel Poison.

See "Strychnine Preparations."

Squirrel Poison-Phosphorus.

See "Phosphorus Preparations."

Stallard's New Lice Exterminator.

(MANUFACTURER NOT STATED.)

Found: Moisture 0.16 per cent; free sulphur 73.51 per cent; ferric oxide 23.73 per cent; silica 1.53 per cent.

Cal. Dept. Agr., Spec. Pub. 51, 11 (1925).

Star Water.

(MANUFACTURER UNKNOWN.)

Found: Available chlorine 2.64 per cent.

Conn. Agr. Expt. Sta., Bull. 258, 377 (1924).

Stearns' Electric Rat and Roach Paste.

See "Phosphorus Preparations."

Steraklene.

(CONNECTICUT CHEMICAL & DISINFECTANT CO., NEW HAVEN, CONN.)

	Guaranteed.	Found.
Sodium hypochlorite	8.00	6.13
Available chlorine	....	5.86
Inert matter	92.00	....

Conn. Agr. Expt. Sta., Sample 9466.

Sterilac

(THE STERILAC CO., NORTH CHICAGO, ILL.)

Guaranteed: Active ingredient 94.00 per cent; inactive (mono-hydrated sodium carbonate), 6.00 per cent. "An alkaline chloramine mixture readily soluble in water."

Found: Chloramine T, 94.24 per cent.

Conn. Agr. Expt. Sta., Sample 9658.

Sterling Argentine Ant Poison.

(WESTERN WHOLESALE DRUG CO., LOS ANGELES, CAL.)

	Guaranteed.	Found
Arsenic, metal	0.18	0.12

Cal. Dept. Agr., Spec. Pub. 58, 17 (1925).

Sterling Oil Spray.

See "Oil Emulsions, Mineral."

Sterlingworth Cut Worm Killer.

(STERLING CHEMICAL CO., CAMBRIDGE, MASS.)

	Guaranteed.	Found.
Total arsenious oxide	1.00	1.99
Water-soluble arsenic, metal	0.07	1.40

Conn. Agr. Expt. Sta., Bull. 242, 159 (1924).

Sterlingworth Weed Killer.

(STERLING CHEMICAL CO., CAMBRIDGE, MASS.)

	Guaranteed.	Found.
Arsenic oxide	30.00	30.10

Cal. Dept. Agr., Spec. Pub. 34, 20 (1923).

Stott's Fir-Tree Oil Soap.

See "Soap."

Strawberry Weevil Bait.

(M. R. FORSELL, SEATTLE, WASH.)

Found: Total arsenic oxide 1.54 per cent; water-soluble arsenic oxide 0.61 per cent; calcium oxide 0.42 per cent; magnesium oxide 1.42 per cent; moisture 7.24 per cent. Substance is dried apple waste plus magnesium arsenate.

Canada Dept. Agr., Div. Chem., Rept. Dominion Chemist (1928).

Strychnine Preparations.

See Table XXXI.

Success Special Insecticide.

(VICTORY TREE SPRAY CO., LOS ANGELES, CAL.)

	Guaranteed.	Found.
Sulphur	6.00	7.20
Sodium nitrate	23.00	22.44
Sodium carbonate	39.90	32.99
Soap	10.00	9.27
Water	....	27.41
Inert matter	22.00	....

Cal. Dept. Agr., Spec. Pub. 58, 49 (1925).

Success Tree Spray.

(H. D. BLANCHARD, PORTERVILLE, CAL.)

	Guaranteed.	Found.
Water	....	8.72
Sulphur	20.00	15.63
Sodium nitrate	20.00	19.62
Sodium carbonate	35.00	38.70
Soap	12.00	12.04
Insert matter	11.00	....

Cal. Dept. Agr., Spec. Pub. 51, 55 (1925).

Sulco-V. B.

See "Oil Emulsions, Mineral."

Sulfene.

(F. A. FRAZIER CO., SAN FRANCISCO, CAL.)

	Guaranteed.	Found.
Sodium polysulphide	64.00	65.76
Sodium thiosulphate	22.00	25.60
Free sulphur	2.00	0.45
Sodium sulphate	4.00	....
Water	8.00	....

Cal. Dept. Agr., Spec. Pub. 66, 23 (1926).

TABLE XXXI. STRYCHNINE PREPARATIONS

Manufacturer or Distributor and Brand	Strychnine		Publication
	Guaranteed	Found	
	%	%	
G. H. Benedict and Co. O. K. Squirrel Poison[1]	0.40	0.17	Cal. Dept. Agr., Spec. P 75, 46 (1927).
Brunswig Drug Co., Los Angeles, Cal. Brunswig Squirrel Annihilator	....	0.28	Cal. Dept. Agr., Spec. P 66, 28 (1926).
California Spray Chemical Co., Watsonville, Cal. Ortho Gopher Poison	90.00	89.60	Cal. Dept. Agr., Spec. P 75, 46 (1927).
California Spray Chemical Co., Watsonville, Cal. Ortho Penetrating Poisoned Barley	0.3125	0.443	Cal. Dept. Agr., Spec. P 66, 27 (1926).
California Spray Chemical Co., Watsonville, Cal. Ortho Penetrating Poisoned Barley	0.3129	0.38	Cal. Dept. Agr., Spec. P 66, 27 (1926).
Coffin-Redington Co., Noxem Squirrel and Gopher Poison	0.30	0.29	Cal. Dept. Agr., Spec. P 75, 46 (1927).
B. E. Cole, Hollister, Cal. County Farm Bureau Mixture[2]	....	0.55	Cal. Dept. Agr., Spec. P 51, 51 (1925).
Diamond Milling Co., Livermore, Cal. Poisoned Barley	0.41	0.33	Cal. Dept. Agr., Spec. P 58, 38 (1925).
Herbert F. Dugan. Poisoned Barley.	0.25	0.26	Cal. Dept. Agr., Spec. P 75, 46 (1927).
Herbert F. Dugan. Strychnine Alkaloid	....	99.66	Cal. Dept. Agr., Spec. P 75, 46 (1927).
Dupins Chemical Co., Fort Dodge, Ia. Gopher-Get-'er[3]	....	0.310	Cal. Dept. Agr., Spec. P 34, 53 (1923).
Dupuis Chemical Co. Gopher-Go	0.25	0.37	Cal. Dept. Agr., Spec. P 75, 46 (1927).
Fort Dodge Chemical Co., Fort Dodge, Ia. Gopher Death[4]	....	0.35	Cal. Dept. Agr., Spec. P 34, 53 (1923).
Germain Seed & Plant Co., Los Angeles, Cal. Go-For-Gopher[5]	0.31	0.05	Cal. Dept. Agr., Spec. P 51, 51 (1925).
Germain Seed & Plant Co., Los Angeles, Cal. Go-For-Gopher[5]	31.00	0.15	Cal. Dept. Agr., Spec. P 51, 51 (1925).
Kirk-Geary Co., Sacramento, Cal. Capital Squirrel Poison	0.24	0.23	Cal. Dept. Agr., Spec. P 58, 38 (1925).
Kirk-Geary Co., Sacramento, Cal. Dead Shot Squirrel & Gopher Killer	0.25	0.25	Cal. Dept. Agr., Spec. P 58, 38 (1925).
Kirk-Geary Co., Sacramento, Cal. Dead Shot Squirrel & Gopher Killer	0.24	0.21	Cal. Dept. Agr., Spec. P 58, 38 (1925).
Langley & Michaels Co., San Francisco, Cal. Hall's Lightning Squirrel and Gopher Poison	0.347[6]	0.32[6]	Cal. Dept. Agr., Spec. P 66, 28 (1926).

[1]Cyanide, guaranteed 0.10 per cent; found trace.
[2]Sample is poisoned wheat sweetened with saccharin.
[3]Sample is a poisoned mixture of raisins and figs.
[4]Tablets sweetened with sugar and having an odor of anice.
[5]Sample is poisoned raisins.
[6]Strychnine sulphate.

TABLE XX XI. STRYCHNINE PREPARATIONS—*Concluded.*

Manufacturer or Distributor and Brand	Strychnine		Publication
	Guaranteed	Found	
	%	%	
ıgley & Michaels Co., San Fran-			
isco, Cal. Hall's Lightning Squirrel nd Gopher Poison	0.32[6]	0.30[6]	Cal. Dept. Agr., Spec. Pub. 66, 28 (1926).
ın F. Leinen Chemical Co., San ?rancisco, Cal. Leinen's Poisoned Barley	0.3125	0.449	Cal. Dept. Agr., Spec. Pub. 66, 28 (1926).
ın F. Leinen Chemical Co., San ?rancisco, Cal. Leinen's Poisoned Barley	0.40625	0.36	Cal. Dept. Agr., Spec. Pub. 66, 28 (1926).
ın F. Leinen Chemical Co., San ?rancisco, Cal. Morse's Gopher ?oison	0.3125	0.27	Cal. Dept. Agr., Spec. Pub. 75, 46 (1927).
ın F. Leinen Chemical Co., San ?rancisco, Cal. O-Kay Gopher ?oison	0.25	0.23	Cal. Dept. Agr., Spec. Pub. 75, 46 (1927).
ın F. Leinen Chemical Co., San ?rancisco, Cal. O-Kay Poisoned Wheat	0.25	0.24	Cal. Dept. Agr., Spec. Pub. 58, 39 (1925).
ıg & Gretter, Monterey, Cal. Long nd Gretter's Squirrel Poison	0.20	0.324	Cal. Dept. Agr., Spec. Pub. 66, 28 (1926).
? Specialty Co. El Roy Gopher oison[7]	....	0.25	Cal. Dept. Agr., Spec. Pub. 51, 51 (1925).
tt & Gilbert Co., San Francisco, al. Cespi Poisoned Barley	0.30	0.288	Cal. Dept. Agr., Spec. Pub. 66, 28 (1926).
tt & Gilbert Co., San Francisco, al. Cespi Poisoned Wheat	0.30	0.33	Cal. Dept. Agr., Spec. Pub. Cal.75, 46 (1927).
?. Z. Wait Co. Wait's Squirrel and opher Poison[8]	0.20	0.21	Cal. Dept. Agr., Spec. Pub. 58, 40 (1925).
?stern Wholesale Drug Co. Western oisoned Barley	0.27	0.26	Cal. Dept. Agr., Spec. Pub. 66, 28 (1926).
? M. Willett, San Francisco, Cal. ?akelee's Squirrel & Gopher Poison	0.25	0.61	Cal. Dept. Agr., Spec. Pub. 58, 40 (1925).
?iams & Moore. Moore's Prepared quirrel Poison	0.32	0.33	Cal. Dept. Agr., Spec. Pub. 75, 46 (1927).
G. Woods Chemical Co. Gopher ent	0.20	0.30	Cal. Dept. Agr., Spec. Pub. 75, 46 (1927).
?. Woods Chemical Co. Rat Scent	0.20	0.29	Cal. Dept. Agr., Spec. Pub. 75, 46 (1927).

[6]Strychnine sulphate
[7]Sample is a mixture of poisoned raisins, wheat, etc.
[8]Arsenic guaranteed 0.75 per cent; found 0.57 per cent.

Sulfo.

(MILLER PRODUCTS CO., PORTLAND, ORE.)

	Guaranteed.	Found.
Sulphur	90.00	85.50

Ore. Agr. Expt. Sta., Cir. 84, 11 (1927).

Sulfocide.

(B. S. PRATT CO., NEW YORK, N. Y.)

Two samples:

Sample 18457.

Guaranteed: 30 per cent sulphur as sodium polysulphide and thiosulphate.

Found: Total sulphur 29.25 per cent; thiosulphate sulphur 1.84 per cent; sulphate sulphur 0.10 per cent; sulphide sulphur 27.31 per cent.

Conn. Agr. Expt. Sta., Bull. 242, 160 (1922).

Sample 2506.

Guaranteed: Sodium polysulphide 39-40 per cent; sodium thiosulphate 1-2 per cent; inert matter 58-60 per cent.

Found: Total sulphur 33.78 per cent; monosulphide sulphur 7.79 per cent; thiosulphate sulphur 2.56 per cent; sulphate sulphur 0.25 per cent; polysulphide sulphur 23.18 per cent; sodium polysulphide (calculated as the pentasulphide), 38.48 per cent.

Conn. Agr. Expt. Sta., Bull. 272, 146 (1926).

Sulfodust.

See "Sulphur."

Sulfo-Tobacco Plant and Animal Soap.

See "Nicotine Soaps."

Sulfur.

See "Sulphur."

Sulfur Dusting Mixture Formula No. 5.

See "Naco."

Sulfur-Lime.

See the following:

Dry Mix Sulfur-Lime.

80-20.

Kasulime.

Leinen's Mildew-Go.

Mechling's Dry Mix.

New Jersey Dry Mix Sulfur-Lime.

Niagara Dry Mix.

Sulfur-Nicotine Compound.

See "Nicotine-Sulphur Dusts."

Sulpho-Arsenate Mixture.

(THE KIL-TONE CO., VINELAND, N. J.)

	Guaranteed.	Found.
Sulphur	68.00	68.57
Total arsenic, metal	....	2.47
Water-soluble arsenic, metal	....	0.19

N. J. Agr. Expt., Sta., Bull. 407, 13 (1924).

Sulpho-Arsenate Powder.

(THE KIL-TONE CO., VINELAND, N. J.)

(See also "Green Cross")

	Guaranteed.	Found.
Total arsenic, metal	9.48	9.69
Water-soluble arsenic, metal	0.66	0.19
Sulphur	48.50	49.73

N. J. Agr. Expt. Sta., Bull. 441, 12 (1926).

Sulphur Carbolate of Lime.

See "Whitney."

"Sulpho-Tobacco" Soap.

(R. W. HUNT, SAN JOSE, CAL.)

	Guaranteed.	Found.
Nicotine	0.13	0.03
Sulphur	3.88	0.78

Cal. Dept. Agr., Spec. Pub. 34, 47 (1923).

Sulpho-Tone.

(LUCAS-KIL-TONE CO., VINELAND, N. J.)

Guaranteed: Sulphur 60.00 per cent.

Found: Sulphur 62.48 per cent; coarser than 100 mesh, 0.86 per cent; passes 100 mesh, 99.14 per cent; 200 mesh, 57.37 per cent; 300 mesh, 14.75 per cent.

N. J. Agr., Expt. Sta., Bull. 459, 8 (1927).

Sulphur.

See Table XXXII.

Sulphur-Arsenate Dust 83-15.

(JOHN BACON, GASPORT, N. Y.)

	Guaranteed.	Found.
Total arsenic, metal	2.80	2.44
Water-soluble arsenic, metal	0.15	0.14
Sulphur	83.00	84.75

Conn. Agr. Expt. Sta., Bull. 272, 147 (1925).

Sulphur-Arsenate Dust 90-10.

(JOHN BACON, GASPORT. N. Y.)

	Guaranteed.	Found.
Total arsenic, metal	1.90	1.86
Water-soluble arsenic, metal	0.10	0.11
Sulphur	88.50	88.27

Conn. Agr. Expt. Sta., Bull. 272, 147 (1925).

TABLE XXXII. SULPHUR

Manufacturer or Distributor and Brand	Sulphur		Water	Ash	Type	Publication
	Guaranteed	Found				
	%	%	%	%		
Batelle & Rennick, New York, N. Y.[1] 99½% Pure Superfine Commercial	99.50	99.70	....	....	....	N. J. Agr. Expt. Sta., Bull. 459, 8 (1927).
Cabco Supply Stores. Cabco Flour	90.00	91.40[2]	....	....	....	Cal. Dept. Agr., Spec. Pub. 75, 28 (1927).
Cabco Supply Stores. Cabco	92.00	93.50	....	....	....	Cal. Dept. Agr., Spec. Pub. 75, 28 (1927).
California Associated Buyers Co., Fresno-Selma, Cal. "Lilly"	100.00	99.86	0.12	0.02	Sublimed	Cal. Dept. Agr., Spec. Pub. 58, 23 (1925).
California Rex Spray Co. Rex Sulfur Paste	46.00	48.92	....	....	....	Cal. Dept. Agr., Spec. Pub. 34, 57 (1922).
California Spray Chemical Co., Watsonville, Cal. Ortho Dusting	99.00	99.32	0.09	0.12	Milled	Cal. Dept. Agr., Spec. Pub. 58, 23 (1925).
California Spray Chemical Co., Watsonville, Cal. Ortho-Milled[3]	85.00	87.29	....	....	....	Cal. Dept. Agr., Spec. Pub. 34, 26 (1922).
California Spray Chemical Co., Watsonville, Cal. Ortho Soil	....	99.50	0.33	0.10	Milled	Cal. Dept. Agr., Spec. Pub. 58, 23 (1925).
California Spray Chemical Co., Watsonville, Cal. Ortho	99.00	99.48	0.45	0.08	Milled	Cal. Dept. Agr., Spec. Pub. 58, 23 (1925).
California Spray Chemical Co., Watsonville, Cal. Ortho Wettable	90.00	92.65	1.83	3.52	....	Cal. Dept. Agr., Spec. Pub. 58, 23 (1925).
R. L. Cody. Ventilated[4]	....	99.69	0.21	0.10	....	Cal. Dept. Agr., Spec. Pub. 34, 26 (1922).
D. F. DeBernardi & Co. L. Chambon Fils	100.00	99.88	0.12	none	Sublimed	Cal. Dept. Agr., Spec. Pub. 58, 23 (1925).
F. A. Frazier Co. Frazier's B-7 Dusting[5]	100.00	99.67	0.21	0.12	Milled	Cal. Dept. Agr., Spec. Pub. 51, 21 (1925).

F. A. Frazier Co. Frazier's Dusting Sulphur B-6	90.00	91.62	0.22	8.16	Milled	Cal. Dept. Agr., Spec. Pub. 58, 23 (1925).
General Chemical Co., San Francisco, Cal. Orchard Brand Atomic	45.00	46.10	52.15	....	....	Cal. Dept. Agr., Spec. Pub. 75, 28 (1927).
General Chemical Co., San Francisco, Cal. Orchard Brand Dritomic	90.00	91.20	0.80	....	....	Cal. Dept. Agr., Spec. Pub. 75, 28 (1927).
Granucci Bros., San Francisco, Cal. Columbus Brand	....	97.15[6]	....	....	Milled	Cal. Dept. Agr., Spec. Pub. 58, 23 (1925).
Granucci Bros., San Francisco, Cal. Columbus Sublimed	....	99.40	0.33	0.28	Sublimed	Cal. Dept. Agr., Spec. Pub. 58, 23 (1925).
Granucci Bros., San Francisco, Cal. Columbus Ventilated	....	99.70	0.14	0.16	Milled	Cal. Dept. Agr., Spec. Pub. 58, 23 (1925).
Herbert & Herbert, Inc., Perth Amboy, N. J. Square Brand H.&H. Colloidal	45.00	55.22	....	....	....	N. J. Agr. Expt. Sta., Bull. 459, 9 (1927).
Holland & Holland XXXXX Brand Resublimed Flowers	100.00	99.50	0.30	0.20	....	Cal. Dept. Agr., Spec. Pub. 75, 28 (1927).
Kutner-Goldstein Co. Fleur de Lis Soufre Sublimed Flowers	100.00	99.60	0.40	....	....	Cal. Dept. Agr., Spec. Pub. 75, 28 (1927).
D. Lima Bros. Co. Marca Fioristilla Ground	....	98.00	0.23	0.61	Milled	Cal. Dept. Agr., Spec. Pub. 58, 23 (1925).
Manufacturer unknown. Colloidal	....	36.30	....	....	....	Conn. Agr. Expt. Sta., Bull. 258, 371 (1924).
Manufacturer unknown. Superfine[7]	....	....	....	....	....	Conn. Agr. Expt. Sta., Sample 6914.
Mechling Bros. Chemical Co., Camden, N. J. Sulfur Dust[8]	....	99.50	....	....	....	N. J. Agr. Expt. Sta., Bull. 459, 8 (1927).

[1]Passes 100 mesh 97.2 per cent; 200 mesh 43.5 per cent; 300 mesh 14.5 per cent.
[2]Calcium hydroxide, guaranteed 10.00 per cent; found 7.14 per cent.
[3]Inert matter guaranteed 15.0 per cent.
[4]Passes 200 mesh 97.0 per cent.
[5]Passes 200 mesh 95.0 per cent.
[6]Copper sulphate 2.73 per cent.
[7]Passes 300 mesh 100 per cent.
[8]Passes 100 mesh 99.0 per cent; 200 mesh 24.6 per cent; 300 mesh 9.2 per cent.

TABLE XXXII. SULPHUR—*Continued*

Manufacturer or Distributor and Brand	Sulphur		Water	Ash	Type	Publication
	Guaranteed	Found				
	%	%	%	%		
Meyer, Wilson & Co., San Francisco, Cal. Flowers of Sulphur K. R....	99.00	99.10	0.90	....	....	Cal. Dept. Agr., Spec. Pub. 75, 28 (1927).
Murphy Oil Co., East Whittier, Cal..	....	99.73	0.27	none	....	Cal. Dept. Agr., Spec. Pub. 34, 26 (1922).
Chas. C. Navlet Co., Berkeley, Cal. Neutral Brand Dusting.....	99.00	98.20	0.30	1.10	....	Cal. Dept. Agr., Spec. Pub. 75, 28 (1927).
Chas. C. Navelt Co., Berkeley, Cal. Neutral Sulphur, Superfine Flour..	99.50	99.13	0.24	0.63	Milled	Cal. Dept. Agr., Spec. Pub. 58, 23 (1925).
Niagara Sprayer Co., Middleport, N. Y. Niagara Dusting Sulphur. Sulfodust[9].....	93.00	92.40	....	....	....	Conn. Agr. Expt. Sta., Bull. 258, 371 (1924).
Niagara Sprayer Co., Middleport, N. Y. Niagara Kolodust.....	90.00	90.10	....	....	....	Cal. Dept. Agr., Spec. Pub. 75, 28 (1927).
Niagara Sprayer Co., Middleport, N. Y. Niagara Superfine Dusting.....	99.50	99.70	0.20	0.10	....	Cal. Dept. Agr., Spec. Pub. 75, 28 (1927).
Niagara Sprayer Co., Middleport, N. Y. Vesuvius Sublimed Flowers....	100.00	99.85	0.09	0.06	....	Cal. Dept. Agr., Spec. Pub. 66, 21 (1926).
Dr. O'Toole, Sacramento, Cal.....	....	99.46	0.10	0.44	....	Cal. Dept. Agr., Spec. Pub. 34, 26 (1922).
Pacific Guano & Fertilizer Co., Berkeley, Cal. Cropmaker Flowers.....	100.00	99.50	0.40	0.10	....	Cal. Dept. Agr., Spec. Pub. 75, 28 (1927).
Pacific Guano & Fertilizer Co., Berkeley, Cal. Producer Flowers.....	100.00	99.64	0.25	0.11	....	Cal. Dept. Agr., Spec. Pub. 75, 28 (1927).
Pacific Guano & Fertilizer Co., Berkeley, Cal. Sunkist Dusting.....	99.00	97.45	0.35	1.60	....	Cal. Dept. Agr., Spec. Pub. 75, 28 (1927).

Pascal, Dubedat & Co., P. D. C. Rooster Flowers	....	99.44	0.39	0.17	....	Cal. Dept. Agr., Spec. Pub. 66, 21 (1926).
Richards Import & Export Co. Union	99.62	99.57	0.38	0.05	Sublimed	Cal. Dept. Agr., Spec. Pub. 58, 24 (1925).
D. Rubino. Angelo Pontillo	90.00	99.71	0.08	0.21	....	Cal. Dept. Agr., Spec. Pub. 66, 21 (1926).
San Francisco Sulphur Co., San Francisco, Cal. Alfa Brand Dry Wettable Flowers	90.00	92.50	....	....	....	Cal. Dept. Agr., Spec. Pub. 75, 29 (1927).
San Francisco Sulphur Co., San Francisco, Cal. Anchor Sublimed Velvet Flowers	100.00	99.80	0.20	....	....	Cal. Dept. Agr., Spec. Pub. 75, 29 (1927).
San Francisco Sulphur Co., San Francisco, Cal. Asti Sublimed Sulphur, 100% Pure	100.00	100.00	....	....	Sublimed	Cal. Dept. Agr., Spec. Pub. 58, 24 (1925).
San Francisco Sulphur Co., San Francisco, Cal. Diamond S Flour	100.00	99.65	0.23	0.12	Milled	Cal. Dept. Agr., Spec. Pub. 58, 24 (1925).
San Francisco Sulphur Co., San Francisco, Cal. Eagle Sublimed Flowers	100.00	99.38	0.22	0.40	....	Cal. Dept. Agr., Spec. Pub. 75, 29 (1927).
San Francisco Sulphur Co., San Francisco, Cal. Electric	99.80	99.85	0.02	0.11	....	Cal. Dept. Agr., Spec. Pub. 75, 29 (1927).
San Francisco Sulphur Co., San Francisco, Cal. Owl Superfine Flour	99.50	98.69	0.18	0.56	....	Cal. Dept. Agr., Spec. Pub. 75, 29 (1927).
San Francisco Sulphur Co., San Francisco, Cal. Red Flag Velvet Flowers	100.00	99.64	0.28	0.09	Sublimed	Cal. Dept. Agr., Spec. Pub. 58, 24 (1925).
San Francisco Sulphur Co., San Francisco, Cal. Swan Brand Superfine Ventilated Dusting	98.50	98.13	0.30	1.57	....	Cal. Dept. Agr., Spec. Pub. 75, 29 (1927).
San Francisco Sulphur Co., San Francisco, Cal. Ventilated[10]	....	99.59	0.25	0.16	....	Cal. Dept. Agr., Spec. Pub. 34, 26 (1923.)
San Francisco Sulphur Co., San Francisco, Cal. XL Sublimed	99.80	99.83	0.07	0.10	Milled	Cal. Dept. Agr., Spec. Pub. 66, 21 (1926).
The Sherwin-Williams Co., Cleveland, Ohio. Sherwin-Williams Dusting	100.00	99.80	0.07	0.13	Milled	Cal. Dept. Agr., Spec. Pub. 58, 24 (1927).

[9]Inert matter guaranteed 7.00 per cent.
[10]Passes 200 mesh 97.00 per cent.

TABLE XXXII. SULPHUR—*Concluded.*

Manufacturer or Distributor and Brand	Sulphur		Water	Ash	Type	Publication
	Guaranteed	Found				
	%	%	%	%		
The Sherwin-Williams Co., Cleveland, Ohio. Sherwin-Williams Ultra Brand Flowers	100.00	99.59	0.22	....	....	Cal. Dept. Agr., Spec. Pub. 75, 29 (1927).
The Sherwin-Williams Co., Cleveland, Ohio. Sherwin-Williams Zephyr Brand Flowers	100.00	99.43	0.38	0.20	....	Cal. Dept. Agr., Spec. Pub. 75, 29 (1927).
Stauffer Chemical Co., Anchor Velvet Flowers	100.00	99.60	0.10	0.30	....	Cal. Dept. Agr., Spec. Pub. 75, 29 (1927).
T. D. Urbahns, Sacramento, Cal. Ortho Sprays—Milled[11, 12]	85.00	90.24	2.02	....	....	Cal. Dept. Agr., Spec. Pub. 34, 26 (1922).
T. D. Urbahns, Sacramento, Cal. Wet-O-Dry XX Wettable Dosch[12]	70.00	71.84	....	....	....	Cal. Dept. Agr., Spec. Pub. 34, 26 (1922).
Western Sulphur Co., Oakland, Cal. Bear Brand Bleaching	100.00	99.50	0.50	....	....	Cal. Dept. Agr., Spec. Pub. 75, 29 (1927).
Western Sulphur Co., Oakland, Cal. Cream of Sulphur	90.00	90.13	0.51	7.83	Milled	Cal. Dept. Agr., Spec. Pub. 58, 25 (1925).
Western Sulphur Co., Oakland, Cal. Poppy Dusting	98.00	99.08	0.15	0.78	....	Cal. Dept. Agr., Spec. Pub. 75, 29 (1927).
T. & S. C. White Co., New York, N. Y. Sulphur Dust 100%–300 Mesh[14]	....	....	....	....	....	Conn. Agr. Expt. Sta., Sample 3620.
Yolo County Purchasing & Selling Corp., Woodland, Cal. Ortho[15]	99.00	99.46	0.32	0.23	....	Cal. Dept. Agr., Spec. Pub. 34, 26 (1923).

[10]Passes 200 mesh 97.0 per cent.
[11]Guaranteed: calcium thiosulphate 4.58 per cent; gypsum 1.63 per cent; casein, 0.46 per cent.
[12]Inert matter guaranteed 15.0 per cent.
[14]Passes 200 mesh 100 per cent.
[15]Passes 200 mesh 83.16 per cent.

Sulphur Compound.

(BOGART CHEMICAL CO., NEW YORK, N. Y.)

(See also "Agricultural Sulphur Compound" and "Niagara Soluble Sulphur Compound").

Found: Soluble sulphur 9.35 per cent.

N. Y. Agr. Expt. Sta., Bull. 348, 93 (1912).

Sulphur Dust.

(NIAGARA DUST CO., KENTVILLE, N. S., CANADA.)

Found: Sulphur 78.60 per cent; total arsenic oxide 4.74 per cent; water-soluble arsenic oxide 0.06 per cent; lead oxide 9.75 per cent; colloidal clay (Bentonite) present.

Canada Dept. Agr., Div. Chem., Rept. Dominion Chemist (1928).

Sulphur Smoke Dusting Mixture

See "Naco."

Sulphur with 7 Percent Nicotine Solution.

Sulphur with 10 per cent Nicotine Solution.

See "Nicotine-Sulphur Dusts."

Summer Mulsion.

Summer Oil.

See "Oil Emulsions, Mineral."

"Sun" Argentine Ant Poison.

(SUN DRUG CO., LOS ANGELES, CAL.)

	Guaranteed.	Found.
Total arsenic, metal	0.20	0.30
Water-soluble arsenic, metal	0.20	0.30

Cal. Dept. Agr., Spec. Pub. 34, 18 (1923).

Sun Miscible Oil.

Sunoco Spray Oil.

See "Oil Emulsions, Mineral."

Sure Death Rat Killer.

(PFEIFFER CHEMICAL CO.)

Found: Arsenious oxide 97.22 per cent.

Cal. Dept. Agr., Spec. Pub. 75, 27 (1927).

Sure Death to Insects.

(H. C. DUSENBERRY, NEW YORK, N. Y.)

Found: Substance is gasoline possibly containing oil of citronella.

U. S. D. A., Bur. Chem., Bull. 68, 56 (1902).

Sure Destruction for Cockroaches and Ants.

(INSECT EXTERMINATOR MFG. CO., COUNCIL BLUFFS, IOWA).

Found: Borax 99.50 per cent; balance pink coloring matter.

U. S. D. A., Bur. Chem., Bull. 68, 43 (1902).

Sure Kill Rat and Roach Paste.

See "Phosphorus Preparations".

Sure-Noxem.

(DEVOE & RAYNOLDS, CHICACO, ILL.)

	Guaranteed.	Found.
Arsenious oxide	2.00	2.10
Sulphur	6.00	16.60

Ore. Agr. Expt. Sta., Cir. 64, 11 (1925).

Sure-Shot.

See "Oils, Mineral."

S. W. Sheep Dip.

See "Phenol Soap Solutions."

T.

Talbot's Bed Bug Powder.

(TALBOT MFG. CO.)

Guaranteed: Sodium acid fluoride 8.00 per cent.
Found: Sodium fluoride 58.46 per cent; ash 4.67 per cent.
Cal. Dept. Agr., Spec. Pub. 75, 63 (1927).

Talcimized Sodium Fluoride.

See "Sodium Fluoride."

Tar Acids and Petroleum Oils.

(R. R. ROGERS CHEMICAL CO.)

Guaranteed: Phenols 20.00 per cent.
Found: Phenols 21.60 per cent; oils 77.35 per cent; non-soap ash 0.02 per cent; moisture 0.40 per cent. Constants of separated oil: Baumé gravity 23.3; unsulphonated oil, 44.40 per cent.
Cal. Dept. Agr. Spec. Pub. 51, 44 (1925).

Thrip Juice.

See "Nicotine Soaps."

Thymo-Cresol.

See "Phenol Soap Solutions."

Tiger Paste.

See "Phosphorus Preparations."

Tizit Tree Spray.

(TIZIT SPRAY MFG. CO., LOS ANGELES, CAL.

	Guaranteed.	Found.
Total arsenic, metal	4.00	3.41
Water-soluble arsenic, metal	0.20	2.25
Lead oxide	16.00	15.55
Sulphur	22.00	23.00
Sodium carbonate	16.00	17.08
Sodium oleate	25.00	24.98
Inert matter	17.00	....

Cal. Dept. Agr., Spec. Pub. 51, 54 (1925).

Tobacco Dusts.

See Table XXXIII.

Tobacco, Ground.

See "Tobacco Dusts."

Tobacco Naphtholene Mixture.

(H. A. STOOTHOFF CO., MT. VERNON, N. Y.)

	Guaranteed.	Found.
Nicotine	0.50	1.02

N. Y. Agr. Expt. Sta., Bull. 384, 297 (1914).

Tobacco Soap.

See "Nicotine Soaps."

Tobacco Tea.

(INDIGO BLUING CO)

Found: Nicotine 0.28 per cent.

Cal. Dept. Agr., Spec. Pub. 34, 52 (1923).

"To-Bak-ine" Liquid.

See "Nicotine Sulphate Solutions."

Todco, Argentine Ant Poison.

(OWL DRUG CO., SAN FRANCISCO, LOS ANGELES, CAL.)

Guaranteed: Arsenic 0.20 per cent.

Found: Arsenic, 0.15 per cent; cane sugar 59.24 per cent.

Cal. Dept. Agr., Spec. Pub. 58, 17 (1925).

Tonicide.

See "Blue Label."

Tree Paint.

(HOOD RIVER SPRAY CO., HOOD RIVER, ORE.)

	Guaranteed.	Found.
Copper	1.00	0.70

Ore. Agr. Expt. Sta., Cir. 84, 15 (1927).

Tree Spray.

See "Tizit" and "Victory."

Treevax.

(TREEVAX CHEMICAL CO., HICKSVILLE, OHIO).

Found: Sulphur 62.00 per cent; potassium nitrate 27.00 per cent; ferric oxide 11.00 per cent.

Mich. Agr. Coll. Expt. Sta., Spec. Bull. 74, 11 (1915).

Trelife.

(THE FERTILSPRAY CO., LOS ANGELES, CAL.)

	Guaranteed.	Found.
Ferrous sulphate	20.00	20.98
Ferric sulphate	20.00	36.85
Copper sulphate	0.45	1.27

Cal. Dept. Agr., Spec. Pub. 75, 45 (1927).

TABLE XXXIII. TOBACCO DUST

Manufacturer or Distributor and Brand	Nicotine		Nicotine-sulphate, Guaranteed	Inert Matter, Guaranteed	Passing 200 mesh	Publication
	Guaranteed	Found				
	%	%	%	%	%	
Z. N. Beach, Wallingford, Conn	....	1.66	....	....	....	Conn. Agr. Expt. Sta., Sample 4715.
Melvin W. Buster, Santa Rosa, Cal	....	2.03	....	....	....	Cal. Dept. Agr., Spec. Pub. 34, 50 (1923).
C. D. Carpenter, Berkeley, Cal	....	2.36	....	....	....	Cal. Dept. Agr., Spec. Pub. 34, 50 (1923).
Lewis Cheeseman, Hatfield, Mass.[1]	....	1.72	....	....	....	Conn. Agr. Expt. Sta., Bull. 242, 155 (1922).
Corona Chemical Co., Newark, N. J.	0.50	0.82	....	....	....	Cal. Dept. Agr., Spec. Pub. 34, 50 (1923).
H. P. Cox, San Francisco, Cal.	....	1.50	....	....	....	Cal. Dept. Agr., Spec. Pub. 34, 50 (1923).
Dosch Chemical Co., Louisville, Ky. Dosch	1.20	0.40	....	....	....	Cal. Dept. Agr., Spec. Pub. 34, 50 (1923).
F. & I. Tobacco Products Co., Lancaster, Pa	1.00	0.93	....	....	....	N. J. Agr. Expt. Sta., Bull. 407, 11 (1924).
Golden Gate Mills, San Francisco, Cal. Impco Poultry Tobacco Dust Worm Cure	0.50	0.73	....	98.50	....	Cal. Dept. Agr., Spec. Pub. 51, 49 (1925).
Hall Tobacco Chemical Co., St. Louis, Mo	....	1.30	....	....	60.00	Conn. Agr. Expt. Sta., Bull. 242, 155 (1922).
International Milling Co., San Francisco, Cal	....	1.16	2.00	98.00	....	Cal. Dept. Agr., Spec. Pub. 34, 50 (1923).
International Milling Co., San Francisco, Cal	....	2.78	5.00	95.50	....	Cal. Dept. Agr., Spec. Pub. 34, 50 (1923).
International Milling Co., San Francisco, Cal	0.50	1.30	....	99.50	....	Cal. Dept. Agr., Spec. Pub. 34, 50 (1923).
R. J. Irwin, Inc., New York, N. Y. No. 2	0.50	0.98	....	....	....	N. J. Agr. Expt. Sta., Bull. 441, 9 (1926).
E. M. Ives, Meriden, Conn	....	0.71	....	....	96.00	Conn. Agr. Expt. Sta., Bull. 272, 148 (1925).
M. E. Jaffa, University of California, Berkeley, Cal.	....	1.09	....	....	....	Cal. Dept. Agr., Spec. Pub. 34, 50 (1923).
Kentucky Tobacco Produce Co	....	0.16	....	....	....	Cal. Dept. Agr., Spec. Pub. 34, 50 (1923).
Montgomery, Ward & Co., Portland, Ore	1.50	1.32	....	....	....	Ore. Agr. Expt. Sta., Cir. 84, 11 (1927).
Chas. W. Muller. Muller's Ground Tobacco	1.00	1.08	....	....	....	Cal. Dept. Agr., Spec. Pub. 75, 34 (1927).
E. J. Reilly, San Francisco, Cal	....	0.60	....	....	....	Cal. Dept. Agr., Spec. Pub. 34, 50 (1923).

[1] Total ash 39.60 per cent; acid-insoluble ash 15.30 per cent; total nitrogen 1.99 per cent.

Trepep.

(PERFECTO SPRAY MFG. CO., LOS ANGELES, CAL.)

Guaranteed: Water 80.00 per cent.

Found: Water 83.60 per cent; soap 3.69 per cent; nicotine 0.26 per cent; copper 0.23 per cent; protein 5.13 per cent; phenols 0.90 per cent; calcium oxide 4.70 per cent; sulphur 0.79 per cent; free ammonia 0.36 per cent.

Cal. Dept. Agr., Spec. Pub. 66, 37 (1926).

Triona.

Triumph.

See "Oil Emulsions, Mineral."

Tuber Tonic.

(SHERWIN-WILLIAMS CO., CLEVELAND, OHIO.)

Found: Total arsenic 23.40 per cent; water-soluble arsenic 0.86 per cent; copper 19.70 per cent.

N. J. Agr. Expt. Sta., Bull. 459, 16 (1927).

Tux-E-Do Mixture.

(SCHOONMAKER & SON, CEDAR HILL, N. Y.)

Found: Total arsenious oxide 2.69 per cent; water-soluble arsenious oxide 1.77 per cent; cupric oxide 5.90 per cent.

N. Y. Agr. Expt. Sta., Bull. 348, 90 (1912).

Twenty Plus Disinfectant.

(MICHEL & PELTON CO., SAN FRANCISCO, CAL.)

	Guaranteed.	Found.
Sodium hypochlorite	12.00	11.91
Available chlorine	....	5.67

Cal. Dept. Agr., Spec. Pub. 51, 53 (1925).

210 Dust Mixture Special.

See "Nicotine Dusts."

Tydol 122.

See "Oils, Mineral."

U.

U. C. Worm Capsules.

(JONES DRUG STORE, PETALUMA, CAL.)

Found: Nicotine 15.59 per cent.

Cal. Dept. Agr., Spec. Pub. 66, 26 (1926).

Universal Brand Neutral Emulsion.

Universal Brand Triona.

Universal Brand Triumph.

Universal Dormant Soluble Oil.

Universal Mealy Bug Spray Oil.

Universal Medol Emulsion.

See "Oil Emulsions, Mineral."

University Capsules.

(THE UNIVERSITY CAPSULE CO., SAN FRANCISCO, CAL.)

	Guaranteed.	Found.
Nicotine	13.00	14.20

Cal. Dept. Agr., Spec. Pub. 66, 26 (1926).

University Poultry Worm Capsules.

(NOVATO PHARMACY, NOVATO, CAL.)

Found: Nicotine 14.81 per cent.

Cal. Dept. Agr., Spec. Pub. 66, 26 (1926).

University Worm Capsules.

(CHICKEN PHARMACY, PETALUMA, CAL.)

	Guaranteed.	Found.
Nicotine	13.00	13.39

Cal. Dept. Agr., Spec. Pub. 75, 35 (1927).

University Worm Capsules No. 1.

(PETALUMA AVIAN PATHOLOGY LABORATORY, PETALUMA, CAL.

	Guaranteed.	Found.
Nicotine	15.00	14.83

Cal. Dept. Agr., Spec. Pub. 66, 26 (1926.)

Urania Green.

(IMPORTED FROM GERMANY).

Found: Total arsenious oxide 57.05 per cent; water-soluble arsenious oxide 4.18 per cent.

Cal. Dept. Agr., Spec. Pub. 34, 16 (1923).

Uspulun.

(THE BAYER CO., INC., NEW YORK, N. Y.)

Guaranteed: Hydroxymercurichlorphenol sulphate 30.00 per cent.
Found: Mercury 19.57 per cent.

Cal. Dept. Agr., Spec. Pub. 75, 62 (1927).

V.

Vaporizing and Fumigating Insecticide.

(EASTERN CHEMICAL CO., BOSTON, MASS.)

	Guaranteed.	Found.
Nicotine	37.00	30.87
Camphor	23.00	13.64
Alcohol	32.00	53.49

U. S. D. A., Bur. Chem., Bull. 68, 47 (1902).

Veltha.

(WM. WOOD & SON, WOODGREEN, LONDON, ENG.).

Found: Sand 32.73 per cent; water 27.00 per cent; carbon 2.31 per cent; sulphur trioxide 19.90 per cent; ferrous oxide 17.90 per cent. Substance is partially dehydrated ferrous sulphate with 35.00 per cent sand and carbon.

U. S. D. A., Bur. Chem., Bull. 68, 48 (1902).

Vermol.

See "Phenol Soap Solutions."

Verm-O-Spray.

(VERM-O-SPRAY PRODUCTS CO., WEST HAVEN, CONN.)

Found: Specific gravity, 15.6° C., 0.8825; trace of ash; flash point 61.0°C.; fire point 64° C.; salicylate present. Substance is a mixture of kerosene and methyl salicylate.

Conn. Agr. Expt. Sta., Bull. 258, 376 (1924).

Victory Tree Spray.

(VICTORY TREE SPRAY CO., LOS ANGELES, CAL.)

	Guaranteed.	Found.
Total arsenic oxide	4.50	5.74
Water-soluble arsenic, oxide	0.50	1.37
Lead oxide	15.00	14.83
Sulphur	25.00	24.85
Sodium oxide	10.00	13.02
Soap	....	3.80

Cal. Dept. Agr., Spec. Pub. 66, 18 (1926).

Vigorol.

(TREE CHEMICAL CO., SAN JUAN BAUTISTA, CAL.).

Guaranteed: Potassium cyanide 5.47 per cent.

Found: Potassium cyanide, 1.66 per cent; nitrate nitrogen 0.31 per cent; ammonia nitrogen 2.24 per cent; organic nitrogen 0.65 per cent; total nitrogen 3.20 per cent; phosphorous pentoxide 3.15 per cent. This is a preparation intended to be injected into the sap of trees. It was found to injure trees, and renewal of license to sell was refused in California.

Cal. Dept. Agr., Spec. Pub. 51, 12, 58 (1925).

Vitedust.

(NIAGARA SPRAYER CO., MIDDLEPORT, N. Y.)

	Guaranteed.	Found.
Copper sulphate	11.00	9.40
Lead arsenate	14.00	12.80

Ore. Agr. Expt. Sta., Cir. 64, 11 (1925).

Volck.

Vulture Oil.

See "Oil Emulsions, Mineral."

W.

Dr. G. Z. Wait's Sheep Dip.

See "Phenol Soap Solutions."

Wait's Squirrel and Gopher Poison.
Wakelee's Squirrel and Gopher Poison.

See "Strychnine Preparations."

Walnut Worm Dust.

See "Ortho Walnut Worm Dust."

War on Ants.

(CANNON CHEMICAL CO.)

Guaranteed: Sugar 20.00 per cent.

Found: Sodium fluoride 45.27 per cent; organic matter 25.05 per cent; sugar 19.72 per cent.

Cal. Dept. Agr., Spec. Pub. 75, 63 (1927).

Waters Bros. Crude Carbolic Acid.

See "Phenol."

Watkin's Germicide Dip and Disinfectant.

See "Phenol Soap Solutions."

Watkin's Louse Killer.

(J. R. WATKINS CO.)

	Guaranteed.	Found.
Nicotine	0.10	0.23
Naphthalene	10.00	10.07

Cal. Dept. Agr., Spec. Pub. 75, 41 (1927).

Watson's Soluble Arsenoid.

(JOHN WATSON CO., INC., HOULTON, ME.)

Guaranteed: Sodium arsenate 80.00 per cent; arsenic, metal 32.20 per cent.

Found: Arsenic, metal 40.09 per cent.

Maine Agr. Expt. Sta., Official Inspections 118, 70 (1925).

Weedicator.

(WEEDICATOR WEED CO.)

	Guaranteed.	Found.
Arsenious oxide	....	7.84
Water	70.00	70.00

Cal. Dept. Agr., Spec. Pub. 75, 25 (1927).

Weed Killer.

(CHIPMAN CHEMICAL ENGINEERING CO., BOUND BROOK, N. J.)

	Guaranteed.	Found.
Salts	45.00	44.10

Ore. Agr. Expt. Sta., Cir. 84, 15 (1927).

Weed Killer.

(HOOD RIVER SPRAY CO., HOOD RIVER, ORE.)

Found: Arsenious oxide 30.00 per cent.

Ore. Agr. Expt. Sta., Cir. 84, 15 (1927).

Weed Killer.

(U. S. SMELTING, REFINING & MINING CO., SALT LAKE CITY, UTAH).

	Guaranteed.	Found.
Sodium arsenite	43.00	44.50

Ore. Agr. Expt. Sta., Cir. 84, 15 (1927).

Weed-Killer No. 1 Thin Liquor.

(F. W. WAITE, EL CENTRO, CAL.)

Found: Arsenious oxide 1.13 lb. per gal.; sodium chloride, 1.94 lb. per gallon.

Cal. Dept. Agr., Spec. Pub. 34, 20 (1923).

Weed Killer, No. 2, Thick Liquor.

(F. W. WAITE, EL CENTRO, CAL.)

Found: Arsenious oxide 8.10 lb. per gal.; sodium chloride 0.14 lb. per gallon.

Cal. Dept. Agr., Spec. Pub. 34, 20 (1923).

Weed Killer, Solid.

(F. W. WAITE, EL CENTRO, CAL.)

Found: Arsenious oxide 1.56 per cent; sodium hydroxide 57.60 per cent; sodium carbonate 38.16 per cent; sodium chloride 1.42 per cent.

Cal. Dept. Agr., Spec. Pub. 34, 20 (1923).

Weevil Bait.

See "Strawberry Weevil Bait."

Wescco Bleaching Water.

Found: Available chlorine 2.89 grams per 100 cc.

Conn. Agr. Expt. Sta., Bull. 258, 377 (1924).

Western Poisoned Barley.

See "Strychnine Preparations."

Whale Oil Soap.

See "Soap."

White Arsenoid (Barium Arsenite).

(ADLER COLD & CHEMICAL WORKS, NEW YORK, N. Y.)

Found: Barium carbonate 44.05 per cent; barium chloride 13.05 per cent; barium oxide 8.18 per cent; free arsenious oxide 27.64 per cent; lead carbonate 1.86 per cent; silica 0.20 per cent; water 4.00 per cent.

Univ. of Calif. Coll. of Agr. Expt. Sta., Bull. 151, 25 (1903).

Whitewash.

See "Wyandotte Detergent."

Whitney's Sulphon Carbolate of Lime.

(WHITNEY CO., NATICK, MASS.)

Found: Sand, 1.14 per cent; carbon dioxide 8.60 per cent; sulphur trioxide 0.16 per cent; calcium oxide 57.42 per cent; magnesium oxide 7.37 per cent; phenol anhydride 1.68 per cent; water and pink dye by difference, 23.63 per cent.

U. S. D. A., Bur. Chem., Bull. 68, 51 (1902).

Williams and Moore Spray Soap.

See "Soap."

Winter Mulsion.

See "Oil Emulsions, Mineral."

W. & M. Antiseptic Sheep Dip.

See "Phenol Soap Solutions".

Wyandotte Detergent (Whitewash).

(MANUFACTURER NOT STATED).

Found: Moisture 4.50 per cent; sand 69.22 per cent; sodium carbonate 10.60 per cent; calcium oxide 1.20 per cent; magnesium oxide 0.35 per cent; soap 10.40 per cent; nicotine none. This substance was sold as a wash to prevent sunburn of trees, but was found of no value for this purpose.

Cal. Dept. Agr., Spec. Pub. 34, 59 (1923).

Wyrol.

See "Oils, Mineral."

X.

XL all.

(G. H. RICHARDS, LONDON, ENG.)

Found: Nicotine 3.41 per cent.

N. Y. Agr. Expt. Sta., Bull. 348, 94 (1912).

XX Mystic XX Spray.

See "Oils, Mineral."

X X X Heavy Emulsion.

X X X Medium Emulsion.

See "Oil Emulsions, Mineral."

Y.

Yellow Label Hydroxide Paste.

See "Mechling."

Youell's Rat Snap.

See "Phosphorus Preparations."

Z.

Zeno.

See "Phosphorus Preparations."

Zenoleum Lice Killer.

(ZENNER DISINFECTANT CO., DETROIT, MICH.)

Found: Nicotine 0.51 per cent.

Mich. Agr. Coll. Expt. Sta., Spec. Bull. 74, 11 (1915).

Zeno Miscible Oil Spray.

See "Oil Emulsions, Mineral."

Zinc Arsenite.

See "Arsenite of Zinc."

Zinc Bordeaux.

(GENERAL CHEMICAL CO., NEW YORK, N. Y.)

	Guaranteed.	Found.
Total arsenic, metal	10.16	10.22
Water-soluble arsenic, metal	1.00	0.25
Copper	15.70	16.07
Zinc	13.31	14.41

Conn. Agr. Expt. Sta., Bull. 242, 154 (1922).

Bulletin 301 February, 1929

Connecticut Agricultural Experiment Station
New Haven, Connecticut

CONTROL STUDIES
ON THE
PLUM CURCULIO
IN
CONNECTICUT APPLE ORCHARDS

Philip Garman and M. P. Zappe

The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to other applicants as far as the editions permit.

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Press of The Wilson H. Lee Co., New Haven, Conn.

Recommendations for Control of Curculios on Apple Trees in Connecticut

(1) Arsenate of lead[1] used at 1½ pounds per 50 gallons of spray mixture—applied four times, two applications being subsequent to the calyx period preferably in a pink, calyx, 7-day and 2-weeks or 17-day schedule. Continue until curculios are well under control or if the infestation is small in the beginning, then omit the 7-day application on all except outside rows around the orchard. Apply sprays after calyx at the rates indicated on page 409

(2) Treat interplanted peaches, or peaches in orchards nearby, using lead arsenate as per spray calendar recommendations and cultivate thoroughly up to the trunks during July.

(3) Take care of wild apples or unsprayed trees in immediate neighborhood if possible, either by removal of trees, spraying them at calyx period with lead arsenate and fish oil sticker, or by collection and destruction of early dropped fruits.

(4) Destroy fence rows bordering orchard and remove stone walls if possible.

(5) For trees in the home garden, additional measures such as collection of dropped fruits, may be practised, keeping them picked up and destroyed from the middle of June on—and the destruction of beetles caught by jarring them from the trees onto a sheet.

[1] $PbHAsO_4$—Acid lead arsenate. Commercial arsenate of lead is commonly sold in Connecticut in this form.

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Control Studies on the Plum Curculio[1] in Connecticut Apple Orchards

Philip Garman and M. P. Zappe

The plum curculio has been recognized as a major enemy of fruits in New England since Colonial days. Records of its occurrence in this country may be found in literature appearing between 1735 and 1750[2], and judging from the amount written since that time it has continued its depredations undiminished in severity, ranking today as one of the most important fruit pests. It is probably a native American insect, which became destructive on the introduction of fruit culture by the colonists.

The studies described in this paper were commenced in 1923, and therefore cover a period of six seasons. Though most of the observations were made at the Station farm at Mount Carmel, the orchard of Mr. C. E. Shepard of the West Woods section of Mount Carmel was placed at our disposal for experimental work. The systematic spraying tests recorded on pages 407-434 represent five seasons' work at the Station farm and four seasons at Mr. Shepard's orchard.

Nature and Extent of the Damage

As the name implies, plums are the favorite food of the curculio and damage to these fruits is always severe. Peaches are likewise attacked and although not seriously in Connecticut, much loss results in some regions. Apricots are about equally preferred to to plums while cherries, nectarines, quinces and pears are sometimes injured. Haws are also said to be infested. Perhaps the most serious damage by the curculio in Connecticut occurs on apples, not necessarily because of the amount of feeding or egg-laying, but because of the importance of the apple crop in the State and the difficulty of controlling it under ordinary conditions.

Injury to Apples

Curculios puncture the fruit of the apple both to feed and to lay eggs. Egg punctures are made during the spring and early summer, whereas feeding punctures may be made at any time. Egg punctures are characteristic for the insect, consisting of small crescentic excavations (Plate IV, a) which may enlarge as the apple grows, often resulting in large arrow-shaped scars (Plate V, a)

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[1] *Conotrachelus nenuphar* Herbst.
Order Coleoptera—Family Curculionidae.

[2] See Quaintance and Jenne, 1912, p. 15.

a quarter of an inch or more across. The crescentic excavation usually prevents the destruction of the egg by growth of the fruit, the egg being placed in the flap at the center of the excavation. Feeding punctures consist of small circular holes often excavated around the edges by the feeding of the beetle, the fall punctures being largely of this type (Plate VI, a, b).

The number of punctures per apple varies with the density of the infestation. On trees sprayed with lead arsenate according to the usual schedule, the number varies from one to five, though occasionally more are encountered. On unsprayed fruit, the number frequently reaches 20 or more per single fruit. Where one or two punctures are present, the value of the fruit is not seriously affected except that it should be removed[1] from the highest grade (Fancy). Where 10 to 20 punctures occur, the value is naturally much less. A few external punctures do not, however, impair the keeping qualities and there is no danger of wormy fruit even where more than this occur, since no larvae develop in fruit remaining on the tree. Expanded curculio marks from punctures made early in the season frequently cover a considerable area and may hurt the sale if put on the market in competition with perfect fruit. The greatest damage, however, results from early feeding punctures which deform the fruit and from larvae which partly develop but are later crushed by the growth of the apple (Plate V, b). Such fruit is much reduced in value.

As to the amount of the injury occasioned, it may be said that a large per cent of the fruit is often affected on unsprayed trees, varying with the abundance of the beetles and the size of the crop. Our experience indicates that they may injure as much as 90 per cent of the entire crop, rendering a large part of it unsalable or fit only for cider. On large trees (12 years or more), a medium crop usually shows greater injury than either a very light or heavy one. Ordinarily 50 to 60 per cent of the fruit is damaged in infested orchards where no spraying is done. The following table shows the degree of injury which is found on untreated trees in sprayed orchards, the percentages representing curculio marked fruit:

TABLE 1

	Orchard	1921	1922	1923	1924	1925	1926	1927
				Per Cent				
Milford.....	A	57	67	60	48	..	23–60	..
Expt. Sta., Mt. Carmel	B	..	..	..	64	61	50	55
Shepard's, Mt. Carmel.	C	..	..	..	..	79	26	40

The above figures would not be especially significant unless a comparison were given with fruit from average commercial orchards. Counts were therefore made in a few orchards in order

[1]Public Acts, State of Conn. 1919, Chapter 295, Section 2.

to obtain figures bearing on the amount of damage to fruit as handled by the average Connecticut orchardist.

TABLE 2—RESULT OF SCORES IN COMMERCIAL ORCHARDS—1928

Variety	Location of Orchard	Total Apples	Number Marked by Curculio	Per Cent Marked	Treatment
Baldwin	Cheshire	749	128	17.2	Dormant and pink sprays dusted 7, 14, 30 days after.
Baldwin	Cheshire	661	36	5.4	Same as above plus prepink spray.
Baldwin	Wallingford	1,333	40	3.3	Dormant oil, pink, calyx, dust 10 days later, July 30.
Wagener	Wallingford	749	49	6.5	
Baldwin	Wallingford	1,179	166	14.2	
McIntosh	Cheshire	535	68	12.7	Pink spray, calyx dust (90-10) 7, 14, 30 days later.
Baldwin	Cheshire	749	128	17.4	Same as above.
Baldwin	Cheshire	659	36	5.5	Same as above plus prepink spray.
Baldwin	Cheshire	1,376	228	16.5	Dormant, pink, delayed calyx sprays; dusted afterwards.
Baldwin	Cheshire	554	123	22.2	
Baldwin	Branford	1,421	42	2.95	Dormant, pink calyx and 4 others last on August 1; all sprays.
Baldwin	Branford	945	102	10.7	Dormant, pink, calyx and 3 others; all sprays.

LIFE HISTORY

The life history of the plum curculio is very well known and has been worked out carefully by many investigators. Therefore, it will be unnecessary to extend this phase of the report unduly, but it will be desirable to give a general outline of the life cycle in Connecticut, developing such points as affect control measures.

Eggs are laid in the crescent-shaped punctures already mentioned. On apples, these punctures begin to be noticed shortly after the petals fall when the apples have reached one-fourth to one-half inch in size. After this, there is a period of three to five weeks (Fig. 28) in the field when egg-laying is continued but the peak of oviposition occurs about June 15, dropping off rapidly and being similar to the abundance curve (Fig. 26, b). In insectary cages, egg-laying has been observed to continue until the second week in July or even the last of July while newly made egg-punctures may be observed on apples in the field as late as July 25.

Length of Life Periods 1924–1925

The eggs hatched in an average of seven days according to our observations, varying from five to 16 days. The egg and larval period in the fruit averaged for this locality 22.9 days, varying from 17 to 39 days; while the average time from the entrance of the larvae into the soil to the formation of the adult was 21.2 days varying from 10 to 31 days. Our total period then from deposition of eggs to emergence of adults averaged 53.4, and varied from 31-67 days. The adult was observed to spend some time in the soil after transforming and there seemed to be considerable lack of uniformity in the maturity reached before they came from the soil. This probably accounts for the rather large variation encountered in the total length of the life cycle. There is, however, considerable difference in the length of the life periods in different years and the summer emergence of the adult has varied accordingly. The following records give a general picture of the periods in 1924–1925.

Table 3

	Average	Range
	Days	
Eggs in fruit	7.0	5–16
Larvae in fruit	15.9	12–23
Larvae in soil	11.6	6–16
Pupae in soil	11.0	8–25
Adult in soil	9.8	....
Total	55.4	31–80

Length of Periods under Different Conditions and Cause of the Variations

It seems probable that the total life period given in the preceding table is shorter than actually occurs in the field in some seasons and the following figures bear on this point. Larvae emerging from dropped fruit collected under experimental trees were placed in field cages in 1924–1925, and the time to the emergence of the beetles observed. It will be seen that the average time spent in the ground is 42.2 days which if added to the periods spent in the fruit as egg and larva: namely, 22.9 days, would equal 65.1 days. This, it would seem, more nearly approaches conditions in the orchard. We know, for instance, that the greatest number of eggs laid about June 15 (1923–1924) in Connecticut and the total period of 65 days would bring the period of adult emergence (second brood) to the maximum for August 19. In 1924 and 1925, the curve (see chart on page 389) came to the maximum on September 1, although since that time it has fallen more nearly on the theoretical date, August 15–20 in 1927, and 10–15 in 1928. Another fact

which supports the late summer emergence idea is the percentage of fall feeding punctures found on the fruit.

TABLE 4

Number Observed		Average Time Spent in Soil, Days
38		37.8
5		36.0
1		32.0
28		42.6
22		50.1
13		34.3
1		49.0
12		52.0
Total...120	Av. of all observations...	42.2 days
	Av. of Averages.....	41.7 days

Thus, from the variety Dutchess (unsprayed) examined on August 26, 1927, .09 per cent were marked with this type of feeding punctures; whereas, Russets picked and scored during October ran as high as 2.0 per cent; Greenings scored September 11 averaged 1.4 per cent while Baldwins scored October 27 but picked about one week earlier averaged 6.5 per cent on some unsprayed trees. The greatest amount of fall feeding is thus seen to occur after the first of September and since the adults will begin to feed within a few days after emergence, they could not well have emerged much earlier than this date. On the other hand, during 1928 when there was a very early emergence of adults, few or no feeding punctures were found on early fruit which would tend to contradict the last statement.

LIFE HISTORY IN 1928

Results of rearing curculios in 1928 indicated that there was a much shorter total life period than occurred in 1924 and 1925 and as a direct result an earlier emergence of adults during August, than was experienced during these years. One hundred individuals reared from eggs during 1928 gave an average cycle of 47.9 days and 28 days from emergence from the fruit until appearance above the soil as adults. Larvae placed in the soil on the same dates (presumably under identical conditions (placed together in small jars) varied as much as three weeks in their period of emergence. In all cases, a normal emergence curve was produced, the peak of the lots obtained early in the season being approximately 27 days, and those obtained later, about 30 days. The following table shows the results obtained for 1928 in rearing curculios from egg to adult and from larva to adult, the latter being obtained from dropped fruits collected in the orchard at Mt. Carmel.

TABLE 5—LENGTH OF TIME SPENT IN SOIL—1928

Date Entered Soil	Date Emerged	Number Observed	Average	Range Days
June 28	July 25–27	4	28	27–30
July 1	July 25–Aug. 6	107	27	24–36
July 7	July 29–Aug. 21	43	27	22–45
July 8	July 31–Aug. 15	44	28	23–28
July 8	Aug. 4–Aug. 21	119	36	27–44
July 8	July 29–Aug. 10	32	26	21–31
July 9	Aug. 1–Aug. 11	32	27	22–32
July 10	July 21–Aug. 11	95	26	21–31
July 10	Aug. 1–Aug. 24	125	27	21–45
July 11	Aug. 6–Aug. 21	65	31	27–41
July 12	Aug. 4–Aug. 11	91	27	23–30
July 15	Aug. 7–Aug. 19	51	28	23–35
July 16	Aug. 11–Aug. 23	114	32	26–39
July 18	Aug. 10–Aug. 21	64	27	23–34
July 23	Aug. 19–Aug. 26	7	29	27–35
July 24	Aug. 17–Aug. 26	4	29	24–33
July 26	Aug. 19–Aug. 27	10	28	24–36
July 27	Aug. 23–Sept. 3	11	30	27–36
July 29	Aug. 23–Sept. 5	16	30	25–38
July 30	Aug. 21–Sept. 3	6	29	22–33
July 31	Aug. 30–Aug. 31	4	31	30–31
Aug. 3	Aug. 26–Sept. 3	4	26	23–29
	July 21–Sept. 5	1,048	28	21–45

TABLE 6—LENGTH OF LIFE CYCLE FROM EGG TO ADULT—1928

No.	Date Eggs Laid	Date Adult Emerged	Number Beetles	Period Days
1	May 30	July 26	1	57
2	June 12–13	July 26	2	43
3	June 12–13	July 28	2	45
4	June 10–11	Aug. 4	1	54
5	June 15–16	Aug. 4	1	49
6	June 24	Aug. 1	1	38
7	June 24	Aug. 3	1	40
8	June 24–5	Aug. 6	1	42
9	June 24–5	Aug. 7	1	43
10	June 21	Aug. 8	1	47
11	June 26	Aug. 9	1	44
12	June 26	Aug. 15	3	50
13	June 26–7	Aug. 9	7	43
14	June 29	Aug. 15	2	47
15	June 29	Aug. 17	3	49
16	June 29	Aug. 19	2	52
17	June 27	Aug. 14	3	48
18	June 27	Aug. 15	1	49
19	June 30	Aug. 15	2	47
20	June 30	Aug. 19	1	51
21	July 1	Aug. 11	1	41
22	July 1	Aug. 15	1	45
23	July 11	Aug. 24	1	55
24	June 28	Aug. 10	3	43
25	June 28	Aug. 11	1	44
26	June 28	Aug. 13	1	46
27	June 28	Aug. 30	1	63
28	July 5	Aug. 26	2	52

TABLE 6—LENGTH OF LIFE CYCLE FROM EGG TO ADULT—1928—*Concluded*

No.	Date Eggs Laid	Date Adult Emerged	Number Beetles	Period Days	
29	July 5	Aug. 29	1	55	
30	July 2	Aug. 17	1	46	
31	July 3	Aug. 13	1	41	
32	July 3	Aug. 19	5	47	
33	July 6	Aug. 15	2	40	
34	July 6	Aug. 19	2	44	
35	July 4	Aug. 6	1	31	
36	July 4	Aug. 14	1	39	
37	July 4	Aug. 17	1	42	
38	July 4	Aug. 19	4	47	
39	July 7	Aug. 31	1	55	
40	July 11	Aug. 30	1	50	
41	July 11	Aug. 31	1	51	
42	July 11	Sept. 5	1	56	
43	July 8	Aug. 19	1	42	
44	July 18	Aug. 22	1	45	
45	July 18	Aug. 25	1	48	
46	July 8	Aug. 26	4	49	
47	July 9	Aug. 24	1	46	
48	July 9	Aug. 26	3	48	
49	July 12	Aug. 30	1	49	
50	July 12	Sept. 5	2	55	
51	July 10	Aug. 30	1	51	
52	July 10	Aug. 31	3	52	
53	July 14	Aug. 31	3	48	
54	July 14	Sept. 9	1	57	
55	July 22	Sept. 14	2	54	
56	July 22	Sept. 17	1	57	
57	July 19	Sept. 17	1	60	
58	July 22–24	Sept. 17	2	56	
59	July 22–24	Sept. 25	1	64	
Total, average and range			100	47.1	31–64

A chart of the various activities of the curculio during the summer is shown in Figure 23. The first phase showing beetles coming from hibernation often begins in April but is not shown on the chart for lack of space. The peaks and relative abundance at different periods are shown together with the dates when the activity began, when it came to the maximum and finally ceased.

As a rule, the curculio lives longer in the adult stage than in any other. Adults of the second generation emerging from the soil during August and September hibernate and appear during May or June of the following year. Mating occurs in August or September but more often in Spring after coming from hibernation. Beetles sometimes live in captivity until October of the second year, making their total life 13 or 14 months. In most instances, however, beetles hibernating successfully, die before the middle of July and the total period for this stage may be said to vary from a few months (for those that fail to survive the winter) to nine to 13 months. The following chart (Fig. 23) indicates the general course of the life history.

Description

No extended scientific description will be attempted here, since the various stages have been frequently described and are shown in Plates I and II. The larva is sometimes confused with that of the Oriental fruit moth, and it may be said that the main gross

Fig. 21. The curculio beetle, its egg and feeding punctures. Enlarged 5 times.

points of difference lie in the curvature of the body and the color. The curculio almost invariably rests in a curved position while the fruit moth is straighter and more active and when mature is

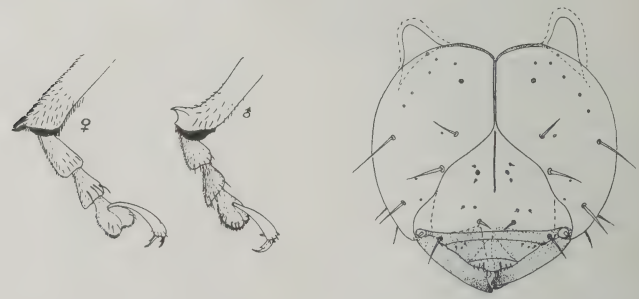


Fig. 22. Structural details of the curculio. Left, hind tibiae and tarsi of adult female and male. Right, head of larva, front view showing punctures and setae.

pink in color. The curculio larva is always white or slightly yellow and possesses no abdominal legs.

There has been some doubt in the authors' minds regarding the number of larval instars, but we have been able to check the

statement of Quaintance and Jenne (1912) on p. 56 and find that there are four instars as stated there. The average width of the head capsule of 10-14 individuals of each instar are as follows: first, .28 mm.; second, .45 mm.; third, .69 mm.; and fourth, .96 mm. The larva is shown in Plate I, b and c, the head capsule in Fig. 22.

The pupa, shown in Plate I, d, is without protection except that it transforms in an earthen cell.

Adults, Plate II, a to d, are small brownish gray snout beetles with elevations of different heights on the wing covers, the beetle itself varying in length from tip of snout to end of abdomen from 5 to 7 mm.

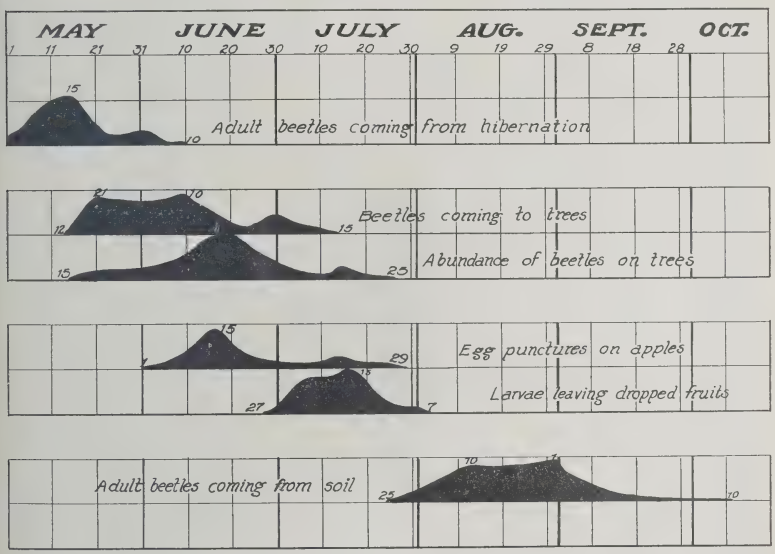


FIG. 23. Chart showing various activities of the curculio. Earliest emergence of hibernating beetles during our experiments occurred April 24. Adult beetles enter hibernation in August and September shortly after emerging from the soil.

When at rest, the adult folds its legs close to the body and if disturbed falls to the ground where it resembles closely a piece of bark or small cinder. The sexes are distinguished by the shape of the hind tibia as shown in Fig. 22.

ABUNDANCE OF THE CURCULIO IN ITS VARIOUS STAGES AND AT DIFFERENT PERIODS OF ACTIVITY

SPRING EMERGENCE OF THE ADULT

Emergence from hibernation begins on the approach of warm weather in the spring. The appearance of beetles depends upon temperature, and apparently upon rainfall in certain seasons. It

has been noted by different authorities and observed during these investigations, that there may be an almost complete absence of beetles in the orchard until a given period dependent upon the temperature or other climatic conditions, when they come suddenly in considerable numbers. During the present investigation, records have been kept of emergence of the adults confined in field cages, from which data it appears that they begin to come from hibernation as a rule when the blossom buds of most varieties

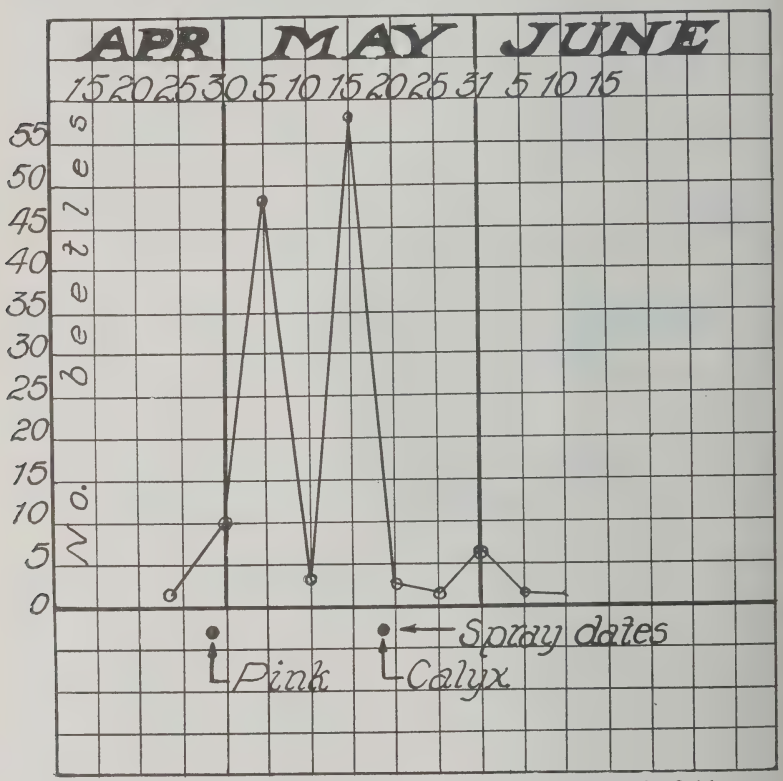


FIG. 24. Emergence of curculio beetles from hibernation in field cages 1925. Varying emergence is probably due to variations in temperature.

are turning pink. The earliest record of emergence thus far obtained is on April 24, 1925, and adults continued to come from the soil until June 12. The best records were obtained in 1925 and 1927 when three distinct waves of emergence were noted probably due to varying temperatures. In 1925, '26, '27 and '28, however, they appeared well on schedule, beginning to appear in numbers when the apple trees had reached the pink blossom bud stage. The data are shown graphically in Figures 23 and 24.

Temperature is, of course, an important factor affecting the time of emergence in spring, and especially the appearance of the beetles on the trees. According to various records (Quaintance and Jenne, 1912, pp. 118-119) the beetles begin usually to be found on the trees after a few days when the thermometer registers 60° F. (mean daily) or above. If the season is dry, the amount of rainfall decidedly affects their emergence from the soil. This is especially true of our observations in field cages where in 1926 the numbers emerging were decidedly increased after heavy rains. In 1927 this condition was not as marked but the following table will show that the greatest emergence occurred after the heaviest rainfall of that period.

TABLE 7—EMERGENCE OF HIBERNATING BEETLES AS AFFECTED BY RAINFALL—1927

Date	Rainfall in Inches	Beetles Emerging in Cages	Temperature, Deg. F.
May 2	tr.	..	.....
3	.05	..	.....
4	....	2	52–62
5	.2	..	.....
7	tr.	1	50–62
10	.2	3	56–62
11	1.05	12	57–71
13	...	..	.....
14	.55	..	.....
15	...	2	53–64
17	.1	..	.....
20	tr.	2	50–64

ABUNDANCE OF BEETLES ON THE TREES

The beetles, however, do not appear on the trees until some time after the first emergence in cages, and the maximum abundance on apple trees is not reached until at least three weeks after the calyx or petal fall spray would normally be applied. On plums, however, their appearance on the trees is somewhat earlier corresponding with the blooming period of some varieties, and the maximum abundance and egg-laying activities do not correspond altogether with the maximum abundance on apples according to our figures. The following charts (Figures 26 and 27) have been prepared to show this phase of the beetles' activities. On apples they begin to appear sometime between the pink and calyx periods, but do not become abundant until later. From the calyx period on, they increase rapidly until about three weeks afterwards when they decrease and gradually disappear, a few stragglers remaining until the middle or even the latter part of July.

EGG LAYING ACTIVITY AT DIFFERENT PERIODS

Extensive observations on the egg laying activities of the curculio in the field were made in 1928, results of fruit examinations being kept during the egg laying period. On apple trees it appears that

the danger period in 1928 lay between June 1 and June 22 (calyx spray applied May 28 in our orchard) during which period sprays should be repeated at least twice for trees that are heavily infested. After June 22, there was a long-drawn-out period continuing until August when a few egg scars were made, which suggests the advisability of infrequent applications after the greatest feeding period is past in order to prevent the small amount of damage which occurs at the later time. Ordinarily, however, this has not been found necessary from the control standpoint, but sprays in July recommended for maggot control should play an important part in preventing damage from the late injury described. Figure 28 shows the injury to apples and other fruits resulting from egg punctures, and Plate IV shows typical egg scars.

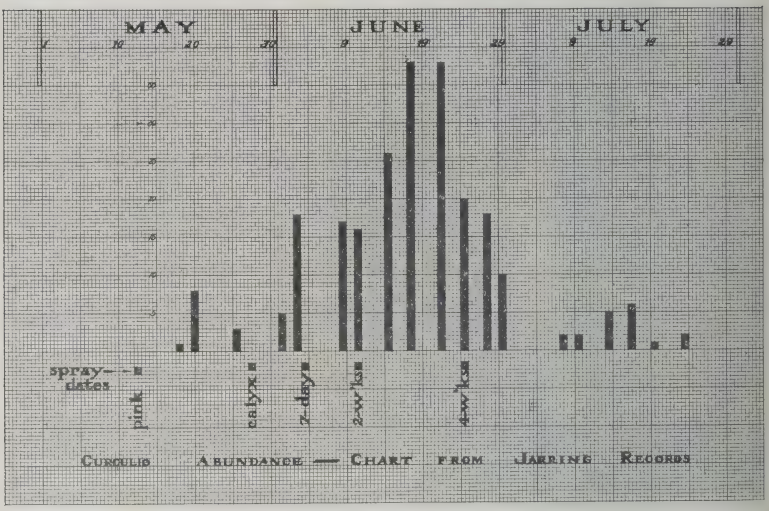


Fig. 25. Curculio abundance on fruit trees constructed from 1926 jarring records, together with spray dates for that year.

It has been thought that some differences might occur in different parts of the State in relation to the earliest egg laying activities. Thus, in 1928, according to the observations of Professor Manter, the calyx spray for apples was begun May 29 at Storrs and on the same date at Mt. Carmel. According to the bioclimatic law[1], there should be a variation of seven days between New Haven and Storrs, Conn., or 11 days between New Haven and Salisbury, while between Mount Carmel and Greenwich there should be no important difference. Such differences must vary from season to season, however, but evidently egg laying at Mount Carmel and Storrs commenced almost simultaneously in 1928.

[1]Hopkins, A. D. The Bioclimatic law and its application to research and practice in Entomology, Jour. Wash. Acad. Sci., 1921; 11: p. 141. According to this law there should be a difference in periodic activity of four days for each one degree of latitude, 5 degrees of longitude and 400 feet of altitude.

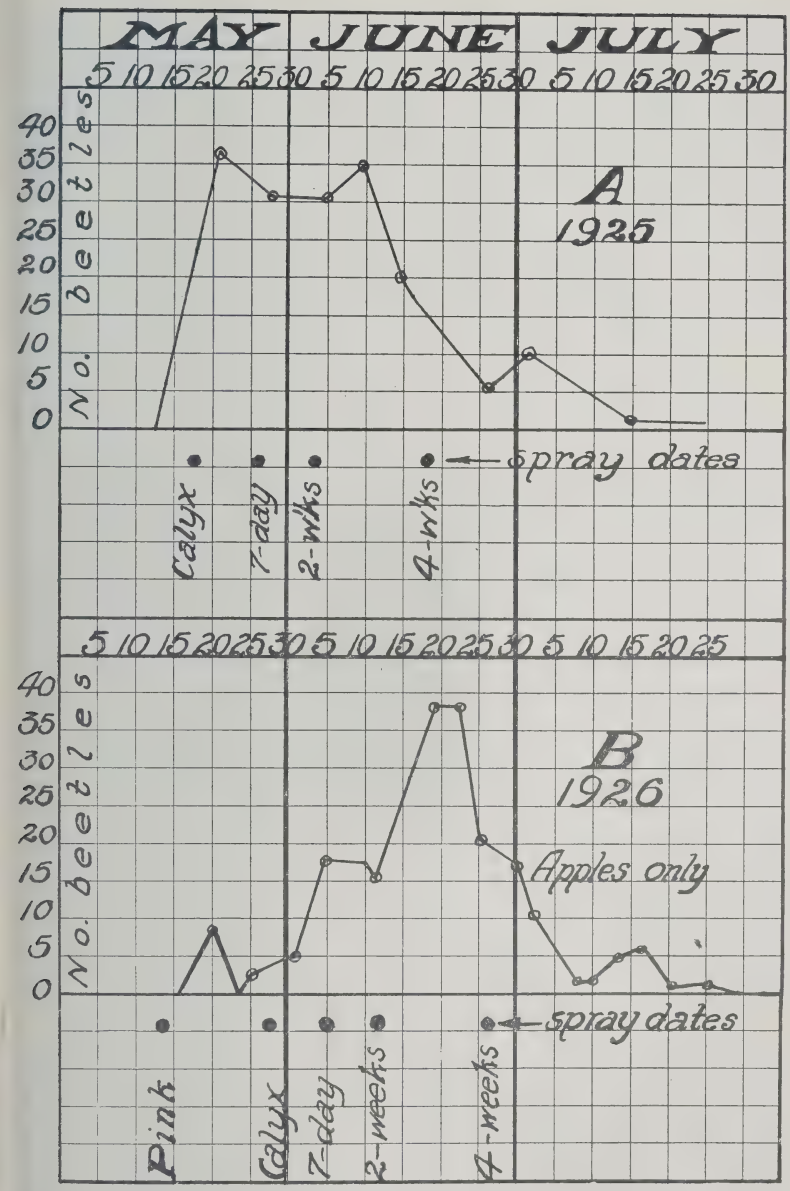


FIG. 26. Chart for comparison of (A) beetles coming to trees from hibernation as determined by removing beetles jarred at frequent intervals and (B) abundance on trees determined by jarring and releasing the beetles after counting.

Larvae Leaving Dropped Fruit

Larvae of the curculio begin to leave the drops in the latter part of June and continue until August. In 1924, the peak was apparently reached about July 15. There was, however, a very sharp rise on the early side, which indicated that that part of the curve was not complete. Similar records kept the following year indicate that the peak of the emergence fell about July 1, some 15 days

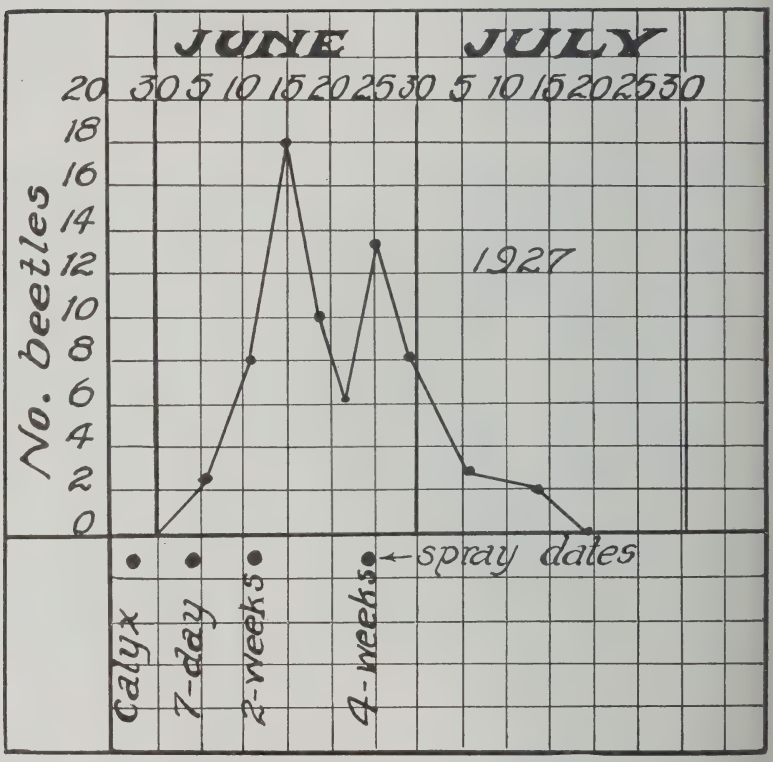


Fig. 27. Showing abundance of beetles on trees in 1927, as determined by jarring and releasing the beetles after counting.

earlier. In 1928, (Table 9) the greatest emergence from fruit occurred about July 10, but there was also a very heavy emergence near the first and during the days intervening. The earliest emergence this year occurred on June 27 and the last on August 7. This indicates that the main part of the brood leave the fruit between July 1 and July 15 or less than a month after the peak of egg laying on apples (Fig. 29). There is some variation from season to season in this phase of the curculios' activity though not so much as might be expected.

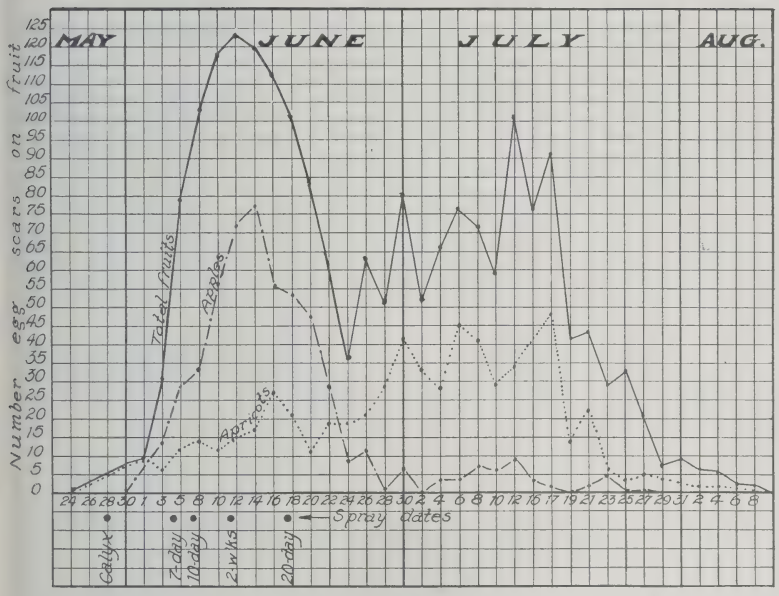


FIG. 28. Abundance of egg scars on fruit of apples, plums and apricots, shown under "total fruits" and apples and apricots separately. The curve for plums was essentially the same as that for apricots. Curves obtained from examination of marked branches every other day.

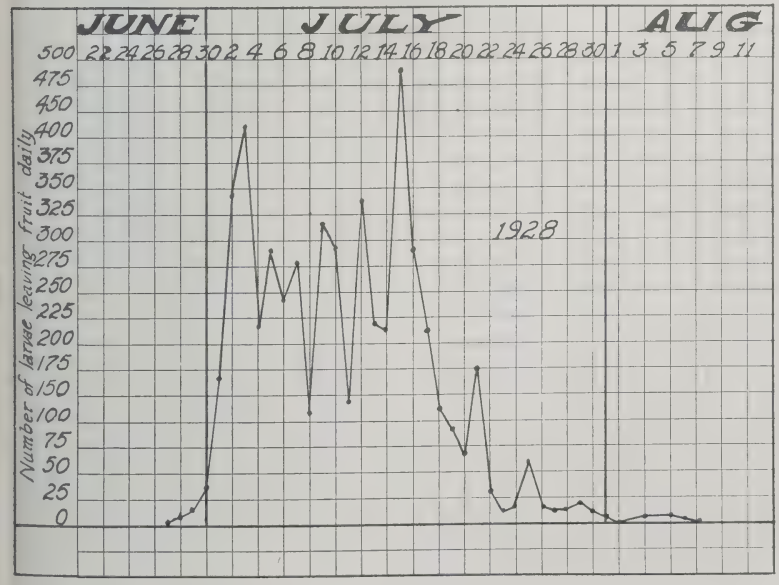


FIG. 29. Chart showing number of larvae leaving dropped fruit daily in 1928.

Emergence of the Second Brood Adults

Adults begin to emerge in insectary cages towards the latter part of July, but few have been obtained in field cages before the first of August except in 1928. Thus in 1924 (Fig. 30), the peak came near the first of September; whereas, during 1926, it came between August 15 and 20, and in 1928, about August 10. The average peak of the adult emergence of the second brood lies about the middle of August, the variation being probably due to weather conditions. In order to predict the exact time of adult peak emergence it would be necessary to obtain temperature data similar to that obtained for the codling moth by Glenn, Shelford and Headlee.

Table 8 shows temperature and rainfall data obtained from the New Haven Weather Bureau for May to August, 1928, the temperature records from this station averaging two or three degrees higher than normally occur in the orchard.

Table 8—Rainfall and Temperature in New Haven—1928

	May		June		July		August	
	Mean Temp.	Rainfall Inches	Mean Temp.	Rainfall Inches	Mean Temp.	Rainfall Inches	Mean Temp.	Rainfall Inches
1	58	.04	66	....	72	Trace	72	.02
2	58	....	72	.34	74	.12	80	....
3	61	....	62		77	....	82	Trace
4	60	....	62	.42	78	.88	85	....
5	58	....	58	1.04	76	1.13	82	.08
6	60	Trace	62	.58	68	1.29	67	.79
7	55	.03	66	Trace	71	....	64	.21
8	51	....	66	....	78	....	71	.05
9	50	.11	64	.49	80	....	78	....
10	56	....	61	....	74	.05	76	.46
11	60	Trace	60	....	75	Trace	75	.24
12	52	....	64	....	78	.01	68	Trace
13	50	....	66	....	72	.24	69	....
14	54	....	70	.45	73	.84	76	....
15	54	....	68	....	74	....	80	....
16	60	....	64	....	76	....	78	....
17	62	....	64	....	78	....	74	.15
18	57	.66	68	.18	82	....	76	.21
19	57	.06	64	1.51	82	....	75	....
20	56	.28	63	....	72	.04	70	....
21	60	....	63	Trace	68	....	72	Trace
22	58	....	58	.20	68	.11	64	.32
23	55	.06	57	Trace	76	.04	64	.56
24	56	.50	66	.19	74	2.40	69	....
25	56	....	72	....	78	....	71	.02
26	59	.36	73	....	73	....	72	.29
27	58	.07	75	.04	74	.02	72	.07
28	60	.02	74	Trace	78	.69	76	.04
29	64	....	69	.50	69	....	82	....
30	64	.07	72	.15	66	....	82	Trace
31	63	....	..	....	68	....	68	Trace
Monthly mean	57.4		65.6		74.3		73.9	
Total precip.		2.26		6.09		7.86		3.51

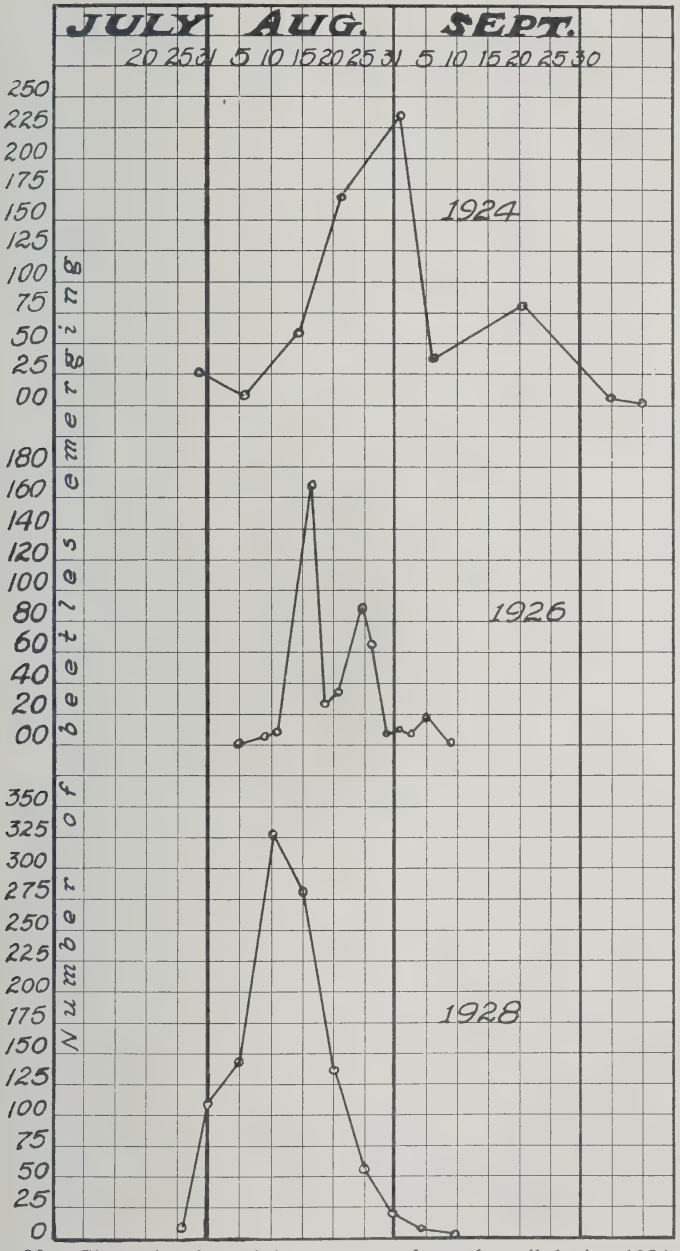


FIG. 30. Chart showing adult emergence from the soil during 1924, 1926 and 1928. Curve for 1928 represents number of emerging adults summed at the end of 5-day intervals.

TABLE 9—EMERGENCE OF LARVAE FROM DROPPED FRUITS—1928

Date	6622 Mixed Plums, Apples and Peach Drops	2779 Peach Drops	1423 Early Apple Drops	3028 Medium Apple Drops	707 Late Drops From Apple	Totals	Apples Only
May 27	1	..	..	..	..	1	..
May 28	6	..	..	..	..	16	..
May 29	14	..	..	..	..	14	..
May 30	..	..	..	..	..	36	..
May 31	..	..	..	..	..	..	..
July 1	170	..	..	..	..	170	..
July 2	349	..	..	..	..	349	..
July 3	417	..	6	..	..	423	6
July 4	214	..	3	..	..	217	3
July 5	170	..	14	2	..	186	16
July 6	227	..	16	2	..	245	18
July 7	224	14	30	8	..	276	38
July 8	73	11	23	4	..	111	27
July 9	156	64	56	43	..	319	99
July 10	135	58	49	49	..	291	98
July 11	67	28	11	39	..	145	50
July 12	146	84	0	100	..	330	100
July 13	80	34	73	36	..	223	109
July 14	84	53	22	59	..	212	81
July 15	130	89	27	241	..	487	268
July 16	88	90	14	119	..	311	133
July 17	41	39	6	126	..	212	132
July 18	20	31	1	67	..	119	68
July 19	14	26	0	54	..	94	54
July 20	12	34	1	13	8	68	22
July 21	11	29	2	70	9	121	81
July 22	3	9	1	7	6	26	14
July 23	0	7	0	4	6	17	10
July 24	0	6	0	3	11	20	14
July 25	3	35	1	10	12	61	23
July 26	2	5	4	3	5	19	12
July 27	1	6	..	3	3	13	6
July 28	4	6	..	2	2	14	4
July 29	1	4	..	2	13	20	15
July 30	0	1	..	2	9	12	11
July 31	2	..	1	1	1	5	3
Aug. 1	0	..	..	..	..	..	..
Aug. 2	0	..	..	..	..	..	..
Aug. 3	1	..	..	..	3	4	3
Aug. 4	0	..	..	..	..	..	..
Aug. 5	0	..	..	..	..	..	..
Aug. 6	0	..	..	1	2	3	3
Aug. 7	1	..	..	1	1	3	2
Total larvae	2,903	763	361	1,071	91	5,189	1,523

HABITS OF THE CURCULIO

Hibernation and Spring Emergence

It is fairly well established that the adult beetles winter in woods, hedge rows or stone walls near the orchard or even in the orchard itself. During the winter, the beetle is very difficult to find and an extended search in peach orchards, apple orchards or woods adjoining may fail absolutely to disclose the hibernating quarters. Probably the most successful attempt to discover the winter quarters is reported by Quaintance and Jenne (1912 p. 130) "At Youngstown, N. Y., in 1905 Mr. Johnson made frequent searches in the fall during October, and on the 14th of that month nine beetles were discovered in a slight depression under an apple tree. They were well covered with closely matted well decayed leaves.....Nine more beetles were found in a similar situation in an apple orchard on the 16th.....On November 7, six more specimens were taken beneath partly rotted leaves close to the soil. The beetles were wet and dull colored from their surroundings.....In the spring of 1905 Mr. Johnson made extended searches for beetles in fence rows, in peach, plum, apple and quince orchards in old stumps in adjoining woods, cracks in fences, under piles of wood and so forth.....None, however, was discovered... The following year, 1906, Mr. Johnson found on April 24, 10 beetles covered with leaves and decayed fruit on the surface of a young apple orchard in sod. At this time the blossom buds were just beginning to open."

In spite, however, of the usual failure to find hibernating beetles in or near orchards, it is almost invariably true that beetles first appear in greater numbers on rows adjoining fence rows or woods, and there can be little doubt that they seek shelter in such situations. A search in Connecticut in 1923 and 1924 failed to reveal the whereabouts of the beetle in the orchard, but a single specimen was found in a woods near one of the orchards. This beetle was found under leaves and trash near the surface of the soil. A second beetle was found during September, 1928 in a dried curled leaf on the edge of a nearby woods. In field cages it has been observed that the beetles leave the apples under which they crawl to feed before hibernation and apparently hide under leaves or trash in the immediate vicinity. In spring before emergence, a search in these cages will reveal beetles on the surface of the soil. Shortly afterwards they may appear in considerable numbers on the netting over the cage. Furthermore, curculios bumped from the trees in spring are frequently covered with clay, indicating that they passed the winter in contact with the soil.

Food of the Beetles

Unlike some other insects the adults of the curculio require food. They will feed upon the leaves of peach and apple, and even upon the petals of the flowers (Plate III, b). Confined in cages with fruit blossoms, they often eat through the calyx cup, evidently in search of sweets. In confinement they have been observed to feed also on sugars of various kinds and seem very fond of honey. Much feeding is of course done on young fruits, of all species which the curculio infests. As to varieties of apples preferred either for food or oviposition there seems to be little choice since feeding and egg punctures have been observed on practically all varieties grown in this state. If there is any choice of variety on the part of the beetle, it is the Dutchess variety which seems to be severely injured in most Connecticut localities. The following table shows that the curculio will develop in many varieties. We have attempted to feed them on other fruits besides those in which the larvae develop but without much success except in the case of

Table 10

Variety	No. of Apples	No of Adults Obtained
Baldwin	100	35
Fall Pippin	60	20
Gravenstein	100	90
Hurlburt	100	39
King	100	29
McIntosh	100	18
Russet	70	9
Stark	70	14

oranges, on the peel of which they will feed to some extent. They will also feed on such mixtures as casein and honey, with just enough water added so that it can be rolled into a ball, and they have been observed to feed on a sponge containing sugar with enough citric acid to make it quite sour. Saccharin was not observed to be attractive to the beetles for food.

Moisture Requirements

Adult curculios require considerable moisture during their lives. Not only does moisture or humidity influence their distribution in the United States, but a certain amount seems to be needed for proper functioning of the life activities. Trees with thick, heavy and abundant foliage, providing abundant dampness in the interior are often heavily infested. In cages, they may be frequently seen taking water from any convenient source or they may be trapped in bottles containing only moist blotting paper placed alongside of equally large bottles containing a natural food supply. Such an experiment was performed, using small glass bottles provided

with wire funnel traps. Apricots were used as the attracting food. The following results were obtained:

TABLE 11

Date	No. Beetles Used	Beetles in Moisture Bottle	Beetles in Food Bottle	Notes
May 31–June 1...	7	5	2	
June 1–2.....	7	5	2	bottles reversed.
June 2–3.....	6	1	5	pair of beetles put in food bottle before starting.
May 28–9.....	6	0	6	check—nothing in moisture bottle.

It is not certain when the beetles take moisture in the field, but it is evident that they are much more active on warm, damp cloudy days than on dry clear ones. One must naturally conclude that moisture or water supply plays a very important role in the biology of the curculio.

Another meteorological factor that affects the curculio is high winds. It is well known that a slight jar is sufficient to make the insect feign death and drop to the ground. It is but natural, therefore, to find them much less abundant on trees, after or during a high wind when the branches are moving about.

Number of Feeding and Egg Punctures

As already noted, the beetles will feed readily upon the fruit. The number of feeding and egg punctures varies in confinement but the following figures will indicate the number usually produced. Quaintance and Jenne give records of individuals making as many as 616 egg punctures although the average for all localities is much lower—101 for Myrtle, Georgia, and 31 for Siloam Springs, Arkansas. The average feeding punctures for these localities is much higher than the number of egg punctures—287 for Arkansas and 161 for Georgia. These figures, however, represent the combined feeding of one pair and indicate that the average feeding punctures per beetle is usually not over 150. Our figures vary from 35-105 egg punctures per female with an average of 79. Feeding punctures per female, however, averaged less than the total number of egg punctures, 46 in number although some individuals fed much more than this.

Egg Laying and Feeding of Adults Emerging During Summer

As already mentioned, no eggs are laid in this locality by beetles emerging during the summer. The greatest damage to the fruit lies in the fall feeding punctures (Plates VI and VII, a) which,

however, have never appeared to be especially abundant in orchards where our experiments were conducted. The following table shows the relative abundance of this type of feeding punctures on sprayed fruit:

TABLE 12—AMOUNT OF FALL FEEDING OF THE ADULT CURCULIO

Date Scored	Total Fruits	Number with Fall Feeding Punctures	Per Cent with Fall Feeding Punctures	Treatment
August and Sept., 1928....	21,362	44	0.2	Sprayed
August and Sept., 1928....	16,181	51	0.3	Sprayed
Sept. and Oct., 1928.....	32,186	112	0.3	Sprayed
Sept. and Oct., 1928.....	18,075	151	0.8	Check—no treatment

The actual percentage of fall feeding punctures on sprayed fruit thus seems to be small and may be disregarded as far as preventive measures are concerned. There is often a considerably greater number on dropped mature fruits than on fruit picked from the trees which is thought to be due to beetles seeking hibernating quarters beneath the trees. The greatest amount of damage due to fall feeding of curculios is recorded in our data for 1926, when it averaged 6.5 per cent on unsprayed Baldwins.

TOTAL NUMBER OF BEETLES DEVELOPING IN APPLES AND POSSIBLE MENACE TO FRUIT OF THE FOLLOWING SEASON

In 1924, all dropped fruits were collected from a sprayed orchard containing two rows of unsprayed trees. All picked fruits were counted in scoring so that the relative number developing in the orchard is apparent. By making certain deductions for mortality, and allowing a conservative number of punctures per beetle (below the average in this case) the percentage of the crop which could be injured during the following year may be roughly estimated. While such figures can never be made to represent the actual condition in the field due to many undeterminable and variable factors, they do show that curculios developing in an apple orchard may offer a considerable menace to the crop during the succeeding year. The estimate is a very conservative one and it seems probable that the amount of damage is often considerably greater.

Total number of fruits in 1925.....	144,435
Total larvae from drops in 1924.....	2,601
Total adults allowing 85% mortality (50% larval mortality, 70% for adults).....	390
Total punctures allowing 100 per beetle..	39,000
Total apples which could be injured allowing 1.5 punctures per apple.....	26,000
Per cent of total crop which could be injured.....	18.0

Reaction of Adult Beetles to Insecticides

In confinement the curculio is more or less easily poisoned with various arsenicals. In the field, however, a tree sprayed with the usual strength of lead arsenate will contain no curculios within 24 hours after spraying; whereas, on unsprayed trees in the immediate vicinity they may be very numerous. Experiments along this line were carried out in 1924 with always the same results; namely, the rapid disappearance of beetles after the poison was applied. This was determined by jarring the trees within 24 hours and placing sheets under the trees to catch fallen beetles. None were taken on the sheets. In cages the most rapid kill that we have yet obtained was 100 per cent in four days, which would indicate that some of the beetles at least should be obtained by jarring in 24 hours. No doubt a fatal dose is obtained shortly after the material is applied and the beetles go elsewhere to die. A report published in Bulletin 32 of the Georgia State Board of of Entomology is interesting in this connection. The authors here confined 372 beetles in an enclosed tree sprayed twice with 3-50 lead arsenate. The following day no beetles could be found feeding on the tree but they all died in 10 days. It seems probable that conditions obtaining here are very similar to field conditions although it does not necessarily prove that arsenate of lead as generally applied (where the dosage is smaller) is a repellant. Probably the substance is repellant in action only after the killing dose is obtained. Our tests, however, indicate a rapid disappearance from trees sprayed with 1½ pounds per 50 gallons.

Various other insecticides have been employed in cage tests, including basic lead arsenate, sodium fluosilicate and ferrous arsenate (scorodite) but none have equaled the lead arsenate in killing power. Sodium fluosilicate mixed with four parts of lime showed considerable value but did not quite equal acid lead arsenate. Basic lead arsenate was only partially effective, a fact made further evident by field tests in 1928. To increase the killing power of certain poisons of low toxicity, various compounds such as lead and zinc stearate were added but without success. These are mentioned on page 406.

Reaction of Beetles to Various Supposed Attractive and Repellent Substances

Curculios are very sensitive to odors. It has been shown by Power and Chestnut[1] that the odorous constituents of apples consist of such compounds as acetaldehyde, amyl esters of formic acid and caproic acid and malic, caproic and capryllic acid. A subsequent research[2] indicated the presence of geraniol. Much

[1]Journ. Amer. Chem. Soc. 42: No. 7: pp. 1509–1526: 1920.
[2]Journ. Amer. Chem. Soc. 44: p. 1498: 1922.

time has been given to a consideration of these compounds from the standpoint of attractives and the only ones which could be detected to have much influence on the beetle are acetaldehyde and malic acid. Both the pure acetaldehyde and the acetaldehyde producing acetaldehyde-sodium bisulphite have been used with similar results. However, when used in the field the beetles have not been successfully trapped by any substance. Probably the scarcity of beetles is one factor influencing results, but another important factor is the high volatility, the odor disappearing within a short time after being placed in the open. This is also true of the repellents tried. Laboratory tests were conducted by placing small specimen bottles (capacity 23 cc.) in one end of a box three

TABLE 13—RESULTS OF TESTS WITH VARIOUS ATTRACTIVE MATERIALS USING LONG BOX PLUS TRAP BOTTLES AT END; COMPARED IN EACH CASE WITH NATURAL FOOD

Substance	Kind of Fruit Compared	Number in Fruit Bottle	Number in Test Bottle	Number Beetles Used
Geraniol	apricots[1]	8	0	10[2]
Granulated sugar and water	apricots	8	0	10
Malic acid plus sugar	apples and apricots	7 6	2 1	9 7
Cal. malate Acet. sod. bisulphite	apples and peaches	6 1 6	2 6 2	8 7 8
Acetal., water, cal. malate, sugar	apricots	3	2	5
Acetal.-cal. malate (dry)	apricots	6	0	6
Moist blotting paper	apricots	2{1 1	5{2 3	7
Moist blotting paper	apricots plus geraniol	2	5	7
Moist blotting paper	apricots plus pair beetles	5	1	6
Empty bottle	apricots	6	0	6

feet long by four inches wide by three inches high with openings at both ends. At one end was connected a short upright tube in which was placed a small electric light. This provided enough heat so that there was a gentle current of air through the box, from one end to the other. Each bottle was provided with a wire cone so that beetles could enter but would remain in the bottle. The tests were begun by placing the beetles in the far end of the box and allowing them to remain over night, the number found in each bottle being recorded the following day. The top of the box was provided with heavy red celluloid made for photographic work. It will be seen here that although the light factor is excluded by use of the red screen and the maze construction of the box, there is

[1]Small green fruits.
[2]Two beetles failed to enter trap bottles.

still a disturbing element in the moisture which accompanies the attractive substances. It is also important as noted by others to use beetles at a time when naturally attracted to their native food plants, for if older beetles are supplied especially after most of the feeding and egg-laying are over, conflicting results may be expected. The Y tubes such as have been devised by McIndoo[1] have also been used with air currents from a suction pump. The unevenness of the air current through the tubes precluded consistent results in the few tests that were made with this type of apparatus.

In view of the fact that moisture apparently played such an important part in the above experiments another series was devised comparing equally large squares of blotting paper, one soaked in pure water, the other soaked in the solution of odorous substances to be tested. The paper did not take up such insoluble substances as lime, but some, of course, was deposited on them.

TABLE 14—COMPARISON OF EQUAL SIZE SQUARES OF BLOTTING PAPER CONTAINING WATER WITH VARIOUS SOLUTIONS OF ODORIFEROUS MATERIALS

Substances Compared	Number in Test Bottle	Number in Moisture Bottle	Number Beetles Used
Calcium malate and acetaldehyde.....	8	1	9
Iso-amyl n-capryllate acetaldehyde, malic acid and lime.....	4	2	8
Same.....	5	2	8

From these results it may be seen that the substances tried had considerable greater attractiveness, yet when we refer to the preceding table it is evident that they do not have nearly as great attractiveness as the natural foods.

The action of repellents was tested in a similar manner except that air was blown through the cage with considerable force with an electric fan. The various substances were placed in the base of the funnel and the fumes blown into the cage with the air. In some of the tests, beetles were first collected on a peach shoot before introduction of the test odor, with the result that they were promptly driven from their natural food to the far end of the box. About 32 substances were tried in this manner with the following results:

TABLE 15

Repellents and Activators	Repellents	Substances Without Apparent Action
Capryl alcohol	Benzaldehyde	Amyl alcohol (Iso)
Iso amyl-n-caproate	Capryl alcohol	Amyl Formate
Iso amyl alcohol	Allyl isothiocyanate	Amyl n-capryllate
Acetaldehyde	Iso-amyl-n-caproate	N.-butyl alcohol
Carbolic acid	Xylene	Anise oil

[1]Journal of Economic Entomology 19: 549–571: 1926.

TABLE 15—*Concluded*

Repellents and Activators	Repellents	Substances Without Apparent Action
Gasoline	Allyl alcohol	Calcium cyanide
Benzaldehyde		Carbon disulphide
Xylene		Chloroform
Allyl iso-thiocyanate		Cider
Allyl alcohol		Clove oil
		Dichloroethane
		Dinitrotoluene
		Ether
		Ethyl alcohol
		Lime sulphur
		Lysol
		Nicotine sulphate
		Octyl alcohol
		Paradichlorobenzene
		Propyl alcohol
		Vinegar

It is worthy of note that such substances as calcium cyanide have little effect, while capryl alcohol and benzaldehyde are strongly repellent. The almost immediate activation of the beetles on the introduction of strong capryl alcohol odor is surprising, the insects running about the cage as if mad.

Application of these apparently repellent substances in the field, however, resulted only in the rapid disappearance of the odor through volatilization, and they consequently had little effect in keeping the beetles from the trees. It is very difficult to select the various repellents in order of their potency and the foregoing list is not intended to convey the impression that one is necessarily more active than another. They have been divided into three lots for convenience. Some of the activator substances were apparently not repellent in the tests conducted and they have therefore been omitted from the repellent list.

There remains the discussion of the protective action of such materials as lime or other non-poisonous material. If we protect a portion of an apple, for instance, with a thick coat of lime, the beetles will feed on the unprotected side. Under natural conditions it is almost impossible to cover completely all sides of an apple unless extremely careful work is done and it is as nearly impossible to maintain this covering over any period of time. It is furthermore difficult to maintain a coat of any thickness so their ultimate value in this regard is doubtful. Lime is sometimes desirable in the spray mixtures, however, for other reasons.

REACTION OF BEETLES TO LIGHT

Confined in cages, the adult curculio beetles are decidedly positive to light, but Quaintance and Jenne have shown that the activities of the female are about equally distributed during the day and the night. The adult beetles have been observed

frequently in the field during the day at rest with legs folded, although when disturbed by jarring they may become active and take flight.

Habits of the Larvae

On emergence from the egg, the curculio larva burrows into the center of the fruit where it continues to feed until a cavity of considerable size is excavated. After the apple drops and the larva becomes full grown, it enters the soil, penetrating to a depth of two inches or less. They rarely go more than three inches below the surface and 90 to 100 per cent will be found within the first two inches. Frequent disturbance of the soil by any means destroys the larvae and the value of cultivation in curculio control is therefore apparent. Undersized larvae often desert fruit and burrow in the ground, but it seems probable that these are stunted mature larvae, forced to abandon the fruit before full size is reached.

Fig. 31. Adult parasite *Triaspis curculionis* Fitch enlarged about 12 times. Left legs, wing and antenna removed.

PARASITES

Parasites of the plum curculio have not been numerous at any time during this investigation. The most abundant, *Triaspis curculionis* Fitch, (Fig. 31) was observed in 1928 and it parasitized about 18 to 33 per cent of the larvae leaving the fruit July 1. The following table shows the relative numbers of this parasite obtained from a large number of larvae, the average parasitism being 5.0 per cent. The species emerged July 15 to August 21.

The only other parasite observed was the egg parasite *Anaphoidea conotracheli* Girault, found during the summer of 1928. This parasite is reported to kill as much as 85 per cent of the eggs of the plum curculio. Quaintance and Jenne mention nine other

TABLE 16—PERCENTAGE OF PARASITISM BY *Triaspis curculionis* FITCH

Date Larvae Entered Soil	Number Curculio Larvae	Number Parasites Emerging	Per Cent Curculio Larvae Parasitized
June 28	6	2	33.3
July 1	170	31	18.2
July 2	22	7	31.8
July 12	50	1	2.0
July 7	96	1	1.0
July 12	32	0	0.0
July 13	128	0	0.0
July 12	91	1	1.0
July 8	118	1	.9
July 16	125	5	4.0
July 17	114	1	.8
	953	48	5.0

parasites, a number of predaceous insects and other enemies. It will suffice here to list these additional enemies together with a few notes on their Connecticut status.

HYMENOPTERA

Thersilochus (*Porizon*) *conotracheli* Riley. Reported from Connecticut and collected by H. L. Viereck on flowers of Ribes species.

Microbracon (Bracon) mellitor Say.

Bracon dorsata Say.

Anisocyrta sp.

Pimpla (Epieurus) sp.

Eurytoma sp.

Cataloccus sp.

Cerambycobius sp.

Microbracon lixi Ashmead.

DIPTERA

Miophasia aenea Wiedemann. Generally distributed over North and South America and probably occurring in Connecticut.

Cholomyia inaequipes Bigot.

PREDACEOUS ENEMIES

Ants, *Dorymyrmex pyramicus* Roger. We do not have this species in Connecticut although other species no doubt play an important part in destruction of curculio larvae.

Lacewings *Chrysopa oculata* Say and other species present in Connecticut orchards.

Thrips. Reported to destroy eggs of the curculio. Observed frequently in or near egg scars and they had apparently destroyed the eggs present in them.

Carabid or ground beetles. Frequently present in Connecticut orchards.

Chauliognathus pennsylvanicus DeGeer. A small brown beetle frequently present. The larvae of this species is said to attack curculio larvae.

Birds of various species are known to feed on curculios.

Moles destroyed a great many larvae in ground cages in 1924. It was found necessary to protect the bottom of these cages against their entrance.

Diseases

Larvae have been observed frequently to die of disease where the soil becomes very damp, and are frequently covered with a white fungus, probably Isaria or Sporotrichum species. The adult beetles have also been found diseased under similar conditions one of the causes being the green muscardine fungus *Isaria anisopliae* (Metch.) commonly attacking grubs in the soil. (See Pl. II, b.)

CONTROL

Before introduction of the arsenicals as insecticides about 60 years ago, horticulturists used various means for combatting curculios. Cultivation, jarring the trees to capture the beetles, allowing live stock to run in the orchard in order to destroy the larvae in drop fruits are a few of the more successful means of control. Besides these there have been forty or more recommendations and suggestions varying from such means as placing chips under the trees to hanging dead mice therein in order to attract the adult beetles which were thought to lay eggs on such material.

The development of arsenicals as insecticides resulted in a material change in control procedures. Arsenate of lead, developed about 1893, brought a further increase in this means of control. Successful sprays were soon developed for control of the curculio and in late years this method has prevailed almost entirely, though accompanied by orchard sanitation, perhaps the most successful of the older means of control. The development of spray controls during the last 25 years and the trend of present day recommendations is well illustrated in the following summary of literature:

Recommendations of Other Investigators

1905. Crandall, C. S., Illinois Agricultural Experiment Station, Bulletin No. 98. Extensive account of apple and plum curculios with detailed field experiments for control. Spraying operations considered unsuccessful; cultivation recommended.

1906. Crandall, C. S., Ibid., Bulletin 106, pp. 219-231.

1921. Fernald, H. T., In Applied Entomology, pp. 137-139. Control (p. 138). "No one method nor even all the methods of control taken together will give entire freedom from this pest. A combination of the treatments, however, will accomplish considerable in this line." Recommends removal of rubbish and hibernating quarters; (2) pruning trees to allow sunlight to enter; (3) allowing fowls and hogs to run under trees or thorough shallow cultivation from time larvae begin to leave fruit until

six weeks later; (4) spraying with arsenate of lead for apples—treatment commonly given for codling moth though similar later applications may also be necessary if the insects are abundant." (5) jarring the trees and collecting the beetles when only a few trees are involved.

1906. Forbes, S. A., Illinois Agricultural Experiment Station, Bulletin 108. Used arsenicals in field tests against the curculio on apples with an average increase of 63 per cent sound fruit over untreated trees.

1914. Headlee, T. J., Report of the Department of Entomology, New Jersey Agricultural Experiment Station for 1913, p. 654. States that where curculio is present foliage must be kept covered with arsenical from time the "creature begins to feed until it disappears." Over-wintering beetles remain in plum orchards about six weeks, in apple orchards for about a month.

1918. Headlee, T. J., Ibid., Report for 1917, pp. 437-438. "Attack seems to have come between blossom-fall and the ten-days-after-blossom-fall spraying." In orchards standing near woodlands or plantings interspersed with old stumps or carpeted with grass, the damage was particularly severe." Recommends clean culture during forepart of season followed by cover crop not producing a dense sod, removal of stumps and cleaning fence rows. Recommends spraying to preserve the coating intact for the first month after blossoms fall.

1919. Headlee, T. J., Ibid., Report for 1918, pp. 212-213. Recommends 7-day spray after calyx. Records two successful cases of control in orchards where curculios were abundant and where crop unsprayed was "ruined by the curculio". Recommends as a schedule for curculio control; "(1) before buds swell; (2) as blossom buds first show color; (3) directly after petals fall; (4) seven days later; (5) 17 days after blossoms fall; (6) June 20 to 30 for all fall and winter varieties. Better results obtained with lime-sulphur and arsenate of lead than with arsenate of lead alone; both have repellent action."

1921. Headlee, T. J., Ibid., Report for 1920, p. 449. Table showing comparison of dust and spray on apples; unsatisfactory control of curculios indicated with dust. Seven to nine per cent injured by curculio.

1923. Headlee, T. J., Ibid., Report for 1922, p. 373. Table showing comparison of dust and spray on apples including curculio records. Dusts do not control curculio as well as sprays.

1924. Headlee, T. J., Ibid., Report for 1923, pp. 274-278, Tables 6, 7 and 8. Results of curculio spraying.

1925. Herrick, Glenn W., In Manual of Injurious Insects, pp. 156-157. "Control measures.—All fence rows, hedge rows and stone walls should be removed from about an orchard. Sunlight on the fallen fruit is fatal to the larvae within, hence judicious pruning to let in the light is useful. Cultivation during late July and early August will destroy pupae in the soil. Thorough spraying with arsenate of lead two pounds to one hundred gallons of water just after the petals fall and again ten days later will be effective if the hibernating places have been destroyed."

1918. Pickett, B. S., Watkins, O. S., Ruth, W. A., and Gunderson, A. J., Illinois Agricultural Experiment Station, Bulletin 206. Contains much valuable information on orchard sprays for the curculio and their results are ably discussed in tables and text. Page 492, under General Summary states: "Codling moth and curculio, as a rule were well controlled by applications of arsenate of lead"; page 493, controls obtained "from 60 to 94 per cent" (in the most successful experiments in 1913) and the least effectively sprayed plats from 32-79 per cent. In 1914 the most effectively sprayed plats showed controls ranging from 81 to 97 per cent and the least effectively sprayed plats from 45 to 87 per cent. In no case did spraying with arsenate of lead fail to exercise a decidedly beneficial effect."

1912. Quaintance, A. L., and Jenne, E. L., U. S. Department of Agriculture, Bulletin No. 103. The most extensive single publication on the plum curculio and its control yet published. Contains summaries of all previous work, data on life history and parasites and accurate studies

of control measures. Page 200 under conclusions states: "with a small amount of fruit and abundance of curculios the most thorough spraying will not serve to bring through a satisfactory amount of sound fruit"—"with a large crop of fruit and abundance of insects, results will likewise be disappointing". Recommends four sprays for apples using dilute fungicide and lead arsenate: (1) as cluster buds are out; (2) as petals fall; (3) three or four weeks after petals fall; (4) nine or ten weeks after petals fall. Secured controls amounting from 19 to 77 per cent increase in sound fruit from sprays tested. The best figures show 91.07 per cent sound fruit as a maximum obtained by the method advocated.

1922. Quaintance, A. L., and Siegler, E. H., U. S. Department of Agriculture, Farmers' Bulletin 1270, pp. 7-10. "Most practical means of control are spraying with arsenate of lead, and cleaning up of trash from the orchards and vicinity as well as thorough cultivation during the summer —the prompt collection and destruction of infested fallen fruit will also aid in reducing this pest." The first spray application to poison the beetles should be applied in pink cluster bud stage, and the second as soon as the petals have dropped, using arsenate of lead at the rate of one pound of powder or two pounds of paste to 50 gallons of water or fungicide. Supplemental treatments are desirable in orchards where the curculio is more than ordinarily destructive.

1914. Slingerland, M. V., and Crosby, C. R., Manual of Fruit Insects, pp. 243-251. Recommends for apples: two sprays as for codling moth just after petals fall and three weeks later—"but where the infestation is severe additional applications will be found necessary." Thoroughness of spraying is essential. Reliance should not be placed on any one method of attack. Clean cultivation, proper pruning, thorough cultivation at proper time are necessary.

1922. Snapp, O. I., Turner, William F., Roberts J. W., U. S. Department of Agriculture, Circular 216. Describes methods used for controlling curculio in the Georgia fruit belt on peaches. Recommends destruction of early drops or disking to destroy pupae and proper orchard sanitation. Jarring the trees also mentioned.

1924. Snapp, O. I., and Alden, C. H., U. S. Department of Agriculture, Bulletin 1205. Dusting and spraying peach trees after harvest for control of the plum curculio. General summary, p. 17 states, "Post-harvest treatments are not advisable except in cases where the curculio infestation has been severe during the peach season". Two applications of 10 per cent lead arsenate and 90 per cent hydrated lime dust are recommended for these treatments.

1928. Sanders, P. D., Trans. Peninsula Hort. Society, pp. 18-23 (Abstr. in Review of Applied Entomology Vol. X. VI: p. 451: 1928.) "Recommendations for control include destruction of overwintering adults by burning woodlands and hedge rows around orchards. Application to peaches of lead arsenate 1-50 or 5 per cent lead arsenate dust, once when petals have fallen and again as shucks are pushing off and cultivation under spread of the tree during second and third weeks after dropping of windfalls.

Besides the literature just quoted, there is considerable published data on the effect of dusts in curculio control with some difference of opinion regarding the merits of the method compared with sprays. Thus Quaintance (1921) p. 224 says "In the case of the plum curculio on apples, dusting compares favorably with spraying where the insect is not especially abundant"...."Under conditions of curculio abundance....dusting is not an effective control and spraying may not furnish the protection desired". The Indiana State report on Horticultural investigations (1919) states that "dusting controlled curculio and codling moth as well as spraying, whereas Cullinan and Baker, Bulletin 283 (1924) of the

Indiana Station state that dusting was inferior to sprays for curculio control in three out of five years work. The work of Stoddard and Zappe at Milford conducted during the years 1920–1924 showed consistent results[1] in favor of spraying although the percentage gain from this method was never great. In addition there are the New Jersey reports comparing dust and spray indicating an advantage for sprays, and in general, opinions favor sprays as better controls.

It is important before discussing any control program to know what conditions surround orchards where most damage is done. A number of typical fruit farms near New Haven were therefore studied. Nearly all Connecticut apple orchards are either cultivated in part or allowed to remain in sod, the orchards in one or the other being about equally divided. Few or no orchardists use clean cultivation. This is due in part to the nature of the land used for this purpose which is often hilly or rolling, and the danger of washing is considerable. There is also much waste or uncultivated land in many localities so that it is almost impossible to locate an orchard without placing it near a wood or within a few rods of numbers of wild apples. Such conditions are primarily responsible for severe infestations commonly found, and it must be recognized that under such conditions heavy infestations of curculio are the rule rather than the exception. Plate VII, b shows a typical wild apple tree.

Conditions Surrounding Ten Representative Orchards

Orchard No. 1. Wallingford. South side of one section near woods reported to be worst; inspection revealed much damage; no wild apples, however, in the vicinity although not far away was an unsprayed orchard; section protected on west by woods. In addition to the woods, a number of peach trees probably supplying many beetles were interplanted with the apples. In another section of the same orchard near a woods on the east side little damage could be seen. This, however, was some distance from the peach trees and the apple orchard mentioned.

Orchard No. 2. Durham. Orchard well in the open though with a fence row on the south. On the north side from a quarter to one-half a mile distant were peach orchards of considerable size.

Orchard No. 3. Middlefield. Large extensive plantings, some of the apples interplanted with peaches. Worst infestations seem to be in these interplanted orchards.

Orchard No. 4. Wallingford. Interplanted orchard, worst conditions in section protected on west by woods, other parts of interplanted orchard said by owner to be less severely injured.

Orchard No. 5. Wallingford. Large plantings some near peach orchards apparently free or with few curculios. No fence rows or woods to protect the orchards although peaches are planted near

[1]Conn. Agr. Expt. Station, Bull. 265; p. 293; 1924.

some of them. The peaches are cleanly cultivated and dusted yearly with arsenate-sulphur-lime dust. Strip cultivations practiced in apple orchards. Plums in bearing near orchard.

Orchard No. 6. Milford. Damage worse on west side adjoining woodland. Orchard in sod or strip cultivation. Fence rows or stone walls around entire orchard, but the worst damage is next the woods as mentioned. Wild apples not far distant.

Orchard No. 7. Branford. Worst damage on outside rows next the woods. Wild apple trees not far distant, but no peaches. Orchard under strip cultivation.

Orchard No. 8. Mount Carmel. Strip cultivation practiced. Worst infestation on west side near fence row, although the latter is low. Young peach orchard also on west side. Other apple trees nearby, but sprayed.

Orchard No. 9. Mount Carmel. Protected on west by fence row and on southwest by wood lot. Wild apples numerous near the orchard. Peach orchards and plum trees to east.

Orchard No. 10. Mount Carmel. About one-fourth mile from No. 9. Not protected on west by fence row, but with bearing peach orchard on south and a few plums on north and west. Damage in this orchard, however, has never been severe for some unknown reason. Orchard in sod. Possibly the plums are sufficiently attractive to draw the beetles away from the apples. Plenty of hibernating quarters nearby.

About the only conclusions which can be drawn from this survey is that the worst damage is done in orchards protected by woods or fence rows on one side (which strange to say seems to be the west side in many of the orchards examined), while those not so protected are not as severely damaged. The presence of peaches in the vicinity seems to have some influence especially if accompanied by woods or fence rows and the presence of wild apples probably has something to do with total number of curculios in an orchard although the survey does not show anything striking in this regard. There is little doubt that beetles develop on these wild fruits since the fruits are abundantly marked and the adults have been jarred from the trees on several occasions. The occurrence of plums or apricots does not seem to influence the severity of infestation as much as peaches.

Preliminary Tests with Various Insecticides

We have already shown that curculios leave the trees shortly after applications of arsenic and it has been well demonstrated that they may be easily killed in confinement when fed on leaves sprayed with the usual dosages. Laboratory tests indicate that the Connecticut curculio is no different in these respects from others, Tables 17-19. It will be noted, however, that death is not immediate and sometimes does not occur until 10 to 12 days after introduction of poisoned food.

TABLE 17—FIVE-DAY TESTS WITH ARSENICALS, FOLIAGE TESTS

Substance Used	Number of Beetles	Date Begun	Number Dead in the Following Days 1	2	3	4	5	% Dead	Notes
Acid lead arsenate 1.2 gm. per 250 cc.	11	June 25	2	8	10		11	100	
Calcium arsenate 1.2 gm. per 250 cc.	8	25	0	5	5		8	100	Beetles excluded from water supply.
Ortho-zinc arsenite 1.2 gm. per 250 cc.	11	25	0	3	4		11	100	
Acid lead arsenate 1.2 gm. per 250 cc. molasses 10 cc....	10	25	1	4	8		9	90	
Ball of casein molasses and lead arsenate.....	8	25	2	5	8		8	100	
Check.....	10	26	0	0	0		0	00	

These tests were made in jars in the insectary, the twigs being sprayed with the solutions indicated and allowed to dry before placing in the jars with curculios.

TABLE 18—TWELVE-DAY TESTS WITH VARIOUS ARSENICALS

Substance Used	Number Beetles	Date	Dead in the Following Days 1	2	3	4	5	6	7	8	9	10	11	12	Per Cent Dead
Acid lead arsenate 1.2 gm. per 250 cc.	10	Aug. 20	1	1	3	0	3	0	5	0	0	7	0	10	100
Ball of casein with 50 gm. casein, 1 gm. lead arsenate, 10 gm. honey; water to make 125 gm..	9	20	0	0	2	0	0	0	5	0	0	9	0	0	100
Check—no treatment	7	20	0	0	0	0	0	0	0	0	0	0	0	0	00

TABLE 19—LABORATORY TESTS WITH POISON DUSTS TO KILL THE PLUM CURCU

(20 beetles used in each jar)

Material	Date Begun	Dead in the following days 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Scorodite 2 gms. Lead stearate 10 gms.....	Aug. 23	1	0	1	0	0	1	0	2	0	0	3	0	3	0	4	
Scorodite 10 gms. Zinc stearate 5 gms.....	23	0	0	0	0	0	2	0	4	0	0	4	0	4	0	4	
Copper fluoride 2 gms. lime 20 gms.	23	1	0	1	0	0	2	0	2	0	0	2	0	3	0	3	
Lead stearate pure.	23	0	0	0	0	0	2	0	4	0	0	5	0	5	0	6	
Zinc stearate pure.	23	1	0	1	0	0	1	0	0	0	0	1	0	1	0	1	2 lost
Magnesium fluoride 20 gms. lead stearate 4 gms..	23	1	0	1	0	0	0	0	1	0	0	3	0	3	0	4	3 lost
Lead peroxide 1 lb. As_2O_5 ¼ oz.....	23	0	0	2	0	0	2	0	2	0	0	2	0	3	0	3	1 lost
Lead arsenate (basic) pure....	23	0	0	2	0	0	6	0	8	0	0	9	0	13	0	14	4 sick
Check.....	23	2	0	2	0	0	2	0	2	0	0	2	0	3	0	4	
Sodium fluosilicate 1 lb. Lime 4 lbs.	10	0	0	6	0	10	0	0	0	11	0	0	11	0	12	0	2 esca
Check.....	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Arsenate sulfur dust 10% lead arsenate	15	0	0	13	0	0	15	0	0	15	0	0	15	0	0	0	2 esca
Check.....	15	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	

NOTE: Insecticides dusted on fruit and placed in jars containing curculio beetles.

Value of Exposing Drops to Direct Sunlight and Collecting Them from Beneath the Trees

Several ground cages were supplied in 1928 with dropped apples and plums containing egg punctures of the curculio and presumably infested by the larvae. Some of these cages were exposed to direct sunlight; others were protected by cotton sheeting; still others by thick building paper excluding all direct sunlight. The following results were obtained.

Table 20

		Number Beetles Emerging	Number Beetles per 100 Fruits
Protected with cotton sheeting	(1) 200 apples	75	
	(2) 75 apples	25	36
Exposed to direct sunlight	(1) 200 apples	25	
	(2) 75 apples	6	11
Protected with building paper	(1) 75 plums	11	14
Exposed to direct sunlight	(1) 75 plums	9	12

There is undoubtedly some advantage from exposure of dropped fruits to direct sunlight but control by this means is far from complete in Connecticut. Raking drops into the open is a comparatively simple operation in completely cultivated orchards, but a difficult one in orchards kept in sod. The time required for collecting drops by hand from a 17-year old tree is at least 30 minutes for one man (tree in sod or partly cultivated) and probably one hour for large trees. To obtain the greatest benefit, this operation requires repetition at least twice during the summer and the cost may be figured at 50 cents to $1.00 per tree for $4.00 a day labor. At best, the operation is expensive, although it is fully recognized that the use of such labor often depends upon the value of the crop. At present the feeling among the growers in this section is that the plan is not practical. There is no reason, however, why such a method cannot be employed to advantage where a few trees are involved, though it should be recognized that complete control will not be obtained where there are other infested fruits in the vicinity; neither will the result of this work be evident until the following year.

Spraying Experiments for Curculio Control—1924–1928

In view of the rather wide variation in recommendations for spray control of the curculio on apple and the failure in several instances to obtain satisfactory results in Connecticut with the schedules in use, a program of control experiments was devised and carried out with a view to finding more satisfactory measures than were available at the beginning. It became apparent at once that the 7-day spray advocated by the New Jersey Station

offered one solution although a difficult one from the standpoint of many growers with large orchards and limited equipment. If some means could be devised whereby this additional spray might be avoided it would be of considerable advantage. It became desirable to find out, therefore, which sprays, if any, could be omitted and it seemed also worth while to distribute the sprays more evenly throughout the life activities of the adult which as shown by the diagram, Figure 25, do not correspond fully with the pink-calyx-7-day-2-weeks schedule. However, the data obtained in 1928 on the egg-punctures of the beetle seem to indicate that a pink, calyx, 2 weeks, or 17-day schedule, piles up the poison on the trees before the peak of this activity is reached, and the amount of damage occasioned by late feeders, being relatively small, can probably be disregarded in commercial orchards of Connecticut. It also seemed desirable to try addition of such substances as molasses as an attractive food for the beetle or any new arsenical substitute which might come into use, because of the danger of foliage injury from the usual mixtures and the growing belief that the arsenical residue on sprayed fruit at harvest is too large. A comparison of dusts and sprays used in a pink, calyx, 7-day and two weeks schedule was tried out in 1928. Nicotine dust was also tried in 1924 and shown to be worthless for control.

Spray Apparatus and Methods Used

All trees were sprayed at first with 12-foot rods, provided with angle disc nozzles. Sprays were applied in 1924 and 1925 with an Arlington XL sprayer furnishing 150-200 pounds pressure and in 1926, 1927 and 1928 with a Bean sprayer furnishing about 250 pounds. Spiral nozzles of the type shown in Plate VIII, a and b, were used in 1926, 1927 and 1928 and were very effective in furnishing a thorough even coating on fruit and foliage. In 1928 an extension of about four feet was used on one of the rods allowing the operator to reach the tops of the trees more easily. With age, the spiral nozzles became worn through the center and allowed a solid stream to issue at the end. One of our nozzles, however, was used for three years before developing this defect, but it would no doubt last a much shorter time in large orchards where kept in continual use. When operating to best advantage, we were able with this apparatus, using two lines of hose, to apply about 1,000 gallons in the course of an eight-hour day.

The method of spraying consisted of passing completely around each tree, coating as thoroughly as possible all parts thereof. The amount applied to each tree varied with the size of the tree, but from calculations made at Shepard's orchard and that of the Experiment farm at Mount Carmel, the amount applied was approximately one gallon at 7-day and two week periods for

every 24 cubic yards.[1] This will mean approximately one gallon or more for every 10 feet of circumference measured around the outer branches of such varieties as Baldwin, McIntosh and Greening, where these varieties are normal in shape and 15-20 years old. The exact amounts as figured would be as follows for the three varieties:

TABLE 21

Circumference, Feet	Gallons Spray		
	Baldwin	Greening	McIntosh
100	16.6	14.1	17.0
80	9.3	6.6	10.4
60	4.7	....	4.8

The volume increases rapidly with circumference, one large Greening tree 125 feet around containing about 760 cu. yards. At the rate mentioned this tree should require about 30 gallons at the 7-day period.

Trees will naturally vary in the number of branches according to the method and amount of pruning and consequently the amount of foliage, but it is believed that the trees experimented upon in two different orchards represent fairly typical conditions for the average Connecticut orchard. The amount applied at the calyx period was about two-thirds the amount of the 7-day because of the smaller amount of foliage, while the pink spray required only one-third of the amount of the 7-day.

The main reason for using the circumference instead of the height in calculating volume lies in the fact that volume seems to be more closely correlated with circumference in our orchards when figured on the formula

$$v \text{ (cu. yds.)} = \frac{C}{4\pi x 27}\left(\frac{0}{2} - .144C\right) = \frac{C}{339.1}\left(\frac{0}{2} - .144C\right)$$

The three varieties mentioned assume a fairly typical shape in middle-aged trees and in older trees if there is plenty of room around each tree. There are cases, however, where the shape of the tree is irregular, due to manner of growth or from being crowded. In the latter cases probably the best method of obtaining the amount of spray would be to rely on careful measurements as suggested by Smith (l. c.) but it is very doubtful whether the orchardist would consider such an operation as practical or even advisable. A certain amount of judgment should always be exercised by the operator, with the aim in view of covering the leaf and fruit surface as completely as possible. A rough estimate of the amounts needed on regular shaped trees can be obtained by

[1]See Smith, Jour. Ec. Ent. 1927. Formula used $v(\text{cu. ft.}) = \frac{C_2}{4\pi}\left(\frac{0}{2} - .144C\right)$.

circumference measurements, as a basis for control operations. It should also be stated that the experimental trees were headed low, the outer branches being quite near to or touching the ground.

Dusting was done with a power Niagara duster, covering both sides of the tree as completely as possible at each application.

In the course of these experiments a total of more that 700,000 individual apples were examined, representing 1,400 barrels of fruit.

Materials Used

Materials used throughout these experiments were standard materials sold on the market and consisted of lead arsenate, dry lime sulphur, casein lime and 40 per cent nicotine sulphate. Nicotine sulphate was omitted wherever possible and the experiments at the Station farm were conducted wholly without this material. At Shepard's Orchard it was used in the early sprays (pink and calyx) in 1925 and 1928, but not in 1926 and 1927.

The casein lime was a standard brand consisting of two parts of lime and one part casein analyzed by the Department of Chemistry and reported in 1925, Bulletin 272, p. 149, under analytical number 2475.

Two brands of lead arsenate were used which have also been analyzed by the Department of Chemistry and reported in Bulletin 272, p. 145, under analytical numbers 2474 and 2464. Both products contained approximately 30 per cent arsenic oxide and .18 per cent water soluble arsenic.

The fish oil used in 1926 and 1927 was purchased on the local market as light pressed menhaden oil, but differed considerably from that obtained from Mr. Ashworth in 1928, in being much thicker and heavier. The analysis of our 1928 material follows:

Specific gravity	.9324
Saponification number	187.4
Iodine number	173.3
Free fatty acids as oleic acid	3.46%

The two dusts used were three per cent nicotine dust, and 90-10 sulphur arsenate dust consisting of 90 per cent finely ground sulphur and 10 per cent lead arsenate.

Experiment Station Orchard

Spraying experiments were begun in 1924, using the Experiment Station orchard at Mount Carmel. This orchard consists of a number of varieties arranged in rows running the length of the orchard or part way through. There are 96 trees in all, arranged in six rows. As far as could be determined, the varieties appeared to show about equal infestations, but with a systematic decrease

in amount of injured fruit from the outside rows towards the center, and being greater in the lower parts of the orchard to the west. Work during this summer was more or less preliminary and consisted of small tests on 7-14 trees each, taking in entire rows or parts thereof, and scoring all fruit from the orchard. Owing to the variation in degree of infestation in the orchard it was recognized that these results could not be fully relied upon, although giving a general indication of the amount of control. Consequently, the tests were continued in 1925 in different locations which procedure gave a considerably better idea of their value. In 1924, it will be seen that there were fully twice as many punctures on the early drop fruits as on the picked fruit and windfalls harvested later, except on the unsprayed trees where the number was about equal. Tree shaving all sprays had slightly more unmarked fruit than any others. The plot having no 7-day spray, however, averaged 85.5 per cent clean as compared with 86.6 per cent for the complete schedule. None of the remaining treatments averaged as high as these.

It should be mentioned here that several factors influence the abundance of curculios on the trees and have been taken into consideration in evaluating results. They are:

(1) Location of the tree in the orchard—outside trees or trees near fence rows are always more heavily infested.

(2) Number of apples per tree. Very few apples on a large sprayed tree are not usually injured. A medium or light crop, one barrel or less, on a tree normally producing six or seven, is usually injured severely while a maximum crop, well sprayed, usually shows a relatively small percentage of punctures.

(3) Size or volume of the tree itself has influenced results.

BLE 22—Results of Spraying Experiments for Control of Plum Curculio on Apple—1924.—Detailed Record

Total No. Apples	No. Good Apples	No. Marked Apples	Total No. Punctures	Per Cent Marked Apples	No. Punctures per Apple	Kind of Fruit Scored	Treatment
664	165	499	1,354	75.0	2.04	Drops	Molasses plus
480	96	384	1,124	80.0	2.34	Drops	lead arsenate
669	410	259	654	38.7	0.98	Windfalls	Calyx and 2
3,409	2,051	1,358	3,238	39.8	0.95	Picked	weeks
5,222	2,722	2,500	6,370	47.8	1.22	Total	
275	36	239	622	86.9	2.26	Drops	
89	2	87	280	97.7	3.15	Drops	
154	24	130	432	84.4	2.80	Windfalls	None
265	60	205	583	77.3	2.20	Picked	
783	122	661	1,917	84.4	2.45	Total	

TABLE 22—RESULTS OF SPRAYING EXPERIMENTS FOR CONTROL OF PLUM CURC ON APPLE—1924—Detailed Record

Tree Nos.	Total No. Apples	No. Good Apples	No. Marked Apples	Total No. Punctures	Per Cent Marked Apples	No. Punctures per Apple	Kind of Fruit Scored	Treatment
B	621	406	215	450	34.6	0.72	Drops	
1– 3,	515	305	210	467	40.7	0.91	Drops	Calyx, 7-d
5–12,	482	404	78	114	16.2	0.24	Windfalls	and 2 weel
14–16	4,428	3,756	672	1,199	15.2	0.27	Picked	*No pink*
	6,046	4,871	1,175	2,230	19.4	0.37	Total	
B 4	322	89	233	515	72.3	1.60	Drops	
and	93	10	83	273	89.2	2.93	Drops	
B 13	292	210	82	166	28.1	0.57	Windfalls	None
	315	220	95	208	30.2	0.66	Picked	
	1,022	529	493	1,162	48.2	1.13	Total	
C	2,386	1,471	915	2,017	38.3	0.84	Drops	
1– 3,	1,429	870	559	1,044	39.2	0.73	Drops	Pink, 7-da
5– 8	764	616	148	232	19.3	0.30	Windfalls	and 2 weel
	3,301	2,739	562	952	17.0	0.29	Picked	*No calyx*
	7,880	5,696	2,184	4,245	27.7	0.54	Total	
C 4	34	7	27	75	79.4	2.20	Drops	
	133	178	55	84	41.3	0.63	Windfalls	None
	363	135	128	263	35.2	0.72	Picked	
	530	320	210	422	39.6	0.79	Total	
C	2,477	786	1,691	4,135	68.2	1.67	Drops	
9–12,	1,638	307	1,331	4,531	81.2	2.77	Drops	Commercia
14–16	1,336	339	997	3,306	74.6	2.47	Windfalls	nicotine
	4,302	1,270	3,032	9,546	70.5	2.22	Picked	dust
	9,753	2,702	7,051	21,518	72.29	2.20	Total	
C 13	1,766	728	1,038	1,910	58.7	1.08	Drops	
	576	105	471	945	81.7	1.64	Drops	
	521	265	256	488	49.13	.93	Windfalls	None
	2,258	805	1,453	3,114	64.35	1.38	Picked	
	5,121	1,903	3,218	6,457	62.83	1.26	Total	
D	803	669	134	251	16.69	0.31	Drops	
1– 3,	1,030	893	137	230	13.30	0.22	Drops	Pink, caly
5– 8	990	853	137	210	13.84	0.21	Windfalls	and 2 week
	4,430	3,781	643	672	14.51	0.15	Picked	*No 7-day*
	7,253	6,202	1,051	1,363	14.49	0.19	Total	
D 4	317	107	210	458	66.24	1.44	Drops	
	228	63	165	375	72.37	1.64	Drops	
	294	99	195	448	66.33	1.52	Windfalls	None
	1,129	326	803	2,360	71.12	2.09	Picked	
	1,968	595	1,373	3,641	69.77	1.85	Total	

BLE 22—RESULTS OF SPRAYING EXPERIMENTS FOR CONTROL OF PLUM CURCULIO ON APPLE—1924—Detailed Record

Tree Nos.	Total No. Apples	No. Good Apples	No. Marked Apples	Total No. Punctures	Per Cent Marked Apples	No. Punctures per Apple	Kind of Fruit Scored	Treatment
D	359	87	272	262	75.76	.72	Drops	
12,	221	63	158	627	71.5	2.83	Drops	Commercial
16	843	286	557	1,957	66.07	2.32	Windfalls	nicotine
	2,160	407	1,753	3,688	81.16	1.70	Picked	dust
	3,583	843	2,740	6,534	76.47	1.87	Total	
13	26	9	17	36	65.38	1.38	Drops	
	66	11	55	217	83.33	3.28	Drops	
	145	51	94	207	64.83	1.42	Windfalls	None
	176	37	139	377	78.98	2.14	Picked	
	413	108	305	837	73.85	2.02	Total	
[illegible]	207	120	87	205	42.1	0.99	Drops	
3,	238	147	191	256	38.27	1.07	Drops	Pink, calyx
12,	328	279	49	93	14.94	0.28	Windfalls	and 7-day;
16	2,921	2,607	314	673	10.3	0.2	Picked	*No 2 weeks*
	3,694	3,053	541	1,227	14.66	0.33	Total	
	97	12	85	50	87.5	0.5	Drops	
	106	34	72	266	67.94	2.5	Drops	
3	106	47	59	154	55.6	1.4	Windfalls	None
	1,168	430	738	2,129	63.0	1.8	Picked	
	1,477	523	954	2,599	64.58	1.76	Total	
	6,320	5,096	1,224	2,266	19.37	0.35	Drops	
1 3,	2,915	2,302	613	1,514	21.03	0.52	Drops	Pink, calyx,
12,	4,561	4,220	341	703	7.45	0.15	Windfalls	7-day and
16	10,487	9,433	1,054	1,728	10.05	0.16	Picked	2 weeks
	24,283	21,051	3,232	6,211	13.31	.25	Total	
	1,070	315	655	1,411	61.2	1.32	Drops	
n	319	39	280	798	87.8	2.50	Drops	
3	194	91	103	194	52.5	1.0	Windfalls	None
	211	69	142	350	67.3	1.66	Picked	
	1,794	514	1,180	2,753	65.7	1.53	Total	
3, C,	3,907	1,404	2,504	5.077	64.1	1.29	Drops	
C &	1,610	342	1,268	3,238	78.8	2.01	Drops	Summary of
	1,706	787	919	2,089	53.9	1.22	Windfalls	all check
13	5,885	2,182	3,703	9,384	62.9	1.59	Picked	trees
	13,108	4,714	8,394	19,788	64.04	1.51	Total	
pial	290	148	142	321	48.96	1.10	Drops	Two sprays of lead arsenate
	831	563	268	519	32.3	.625	Picked	with baits.

TABLE 23—SHOWING COMPARISON OF DIFFERENT SPRAY TREATMENTS
EXPERIMENT STATION FARM—1924

Treatment	Per Cent Unmarked Fruit	Kind of Fruit	Total Per Cent of Unmarked Fruit
No Pink Spray	62.5	Drops	
Calyx, 7-day	——	——	80.57
and 2 weeks	83.9	Picked	
No Calyx Spray	61.6	Drops	
Pink, 7-day and	——	——	72.22
2 weeks	82.5	Picked	
No 7-day Spray	85.2	Drops	
Pink, calyx and	——	——	85.5
2 weeks	85.6	Picked	
No 2 weeks Spray	60.0	Drops	
Pink, calyx and	——	——	82.67
7-day	88.8	Picked	
All Sprays	80.1	Drops	
Pink, calyx, 7-day and	——	——	86.69
2 weeks	90.7	Picked	
	31.6	Drops	
Check—no spray	——	——	35.96
	39.1	Picked	

EXPERIMENT STATION FARM, 1924

Notes:

Trees planted 1911.

Percentage based on counts varying from 3,583 to 24,283 for each treatment.

Peach orchard alongside removed in winter of 1923-24; early drops collected and larvae trapped in cages 1924.

Spray formula used

Lead arsenate	3 pounds
Lime sulphur (liquid)	3 gallons
Casein lime	1 pound
Nicotine sulphate	1 pint
Water	100 gallons

Dates of Spray Applications

Pink	May 13
Calyx	June 2
7-day	June 10
2-weeks	June 16

RESULTS IN 1925

The work was continued in 1925, shifting blocks, and also introducing several new treatments. First a schedule comprising pink, four days after calyx, five days later and two weeks after the five-day spray. (2) use of coated lead arsenate (home made). (3) double the usual strength of lead arsenate and (4) fish oil sticker in calyx spray without lime sulphur. This year the spray containing fish oil plus lead arsenate applied at the calyx period

without lime sulphur was slightly better than any other treatment, although the difference between it and the complete schedule was only 0.2 per cent. The "no calyx" treatment stood high in clean fruit indicating that beetles did not get started in the orchard this year until some time after this period. The trees from which the 7-day spray was omitted were low in percentage of clean fruit. In these tests, the complete schedule again stood practically as high as any other, being only .16 per cent less than the highest score.

TABLE 24—RESULTS OF SPRAYING EXPERIMENTS FOR CONTROL OF PLUM CURCULIO ON APPLE—1925

EXPERIMENT STATION FARM: DETAILED RECORD

Tree Nos.	Kind of Fruit	Total No. of Apples	No. Marked by Curculio	Per Cent Marked Fruit	Total No. of Punctures	Average No. Punctures Per Apple	Treatment Received
A 1–3	Drops	1,656	808	48.79	1,366	.82	Pink: 6 days after calyx
5–8	Picked	6,509	1,156	17.76	1,814	.28	8 days after 6-day; 2 wks. after 8-day;
	Total	8,165	1,964	24.05	3,180	.39	No lime-sulphur at 6-day
A 4	Drops	56	45	80.35	76	1.35	
	Picked	621	488	78.58	1,069	1.72	Check—no treatment
	Total	677	533	78.72	1,145	1.69	
A 9–12	Drops	2,086	1,506	72.20	2,817	1.35	Pink; 6 days after calyx
14–16	Picked	6,879	1,940	28.20	2,834	.41	with coated lead arsenate; 2-weeks
	Total	8,965	3,446	38.43	5,651	.63	
A 13	Drops	267	264	98.87	650	2.43	
	Picked	416	289	69.47	671	1.61	Check—no treatment
	Total	683	553	80.96	1,321	1.93	
B 1–3	Drops	677	395	58.34	745	1.10	Pink; heavy dose lead
	Picked	7,456	636	8.53	1,080	.14	arsenate at calyx and 2-weeks
	Total	8,133	1,031	12.67	1,825	.22	
B 4	Drops	2,104	1,562	74.23	2,950	1.40	
	Picked	3,579	1,514	42.30	2,616	.73	Check—no treatment
	Total	5,683	3,076	54.12	5,566	.98	
B 9–12	Drops	1,887	83	4.40	122	.06	Pink; calyx with fish
14–16	Picked	1,933	149	7.71	233	.12	oil sticker, no lime-sulphur; 2 weeks.
	Total	3,820	232	6.07	355	.09	
B 13	Drops	309	178	57.60	433	1.40	
	Picked	479	273	56.99	704	1.47	Check—no treatment
		788	451	57.23	1,137	1.44	
C 1–3	Drops	5,596	1,052	18.80	1,591	.28	No 2-weeks;
5–12	Picked	17,708	1,358	7.67	2,228	.12	Pink; calyx; 7-day
14–16	Total	23,304	2,410	10.34	3,819	.16	
C 4 and	Drops	71	41	57.74	97	1.36	
13	Picked	699	365	52.21	784	1.12	Check—no treatment
	Total	770	406	52.72	881	1.14	
D 1–3	Drops	6,545	518	7.91	886	.13	All sprays
5–12	Picked	13,318	720	5.40	1,362	.10	Pink; calyx; 7-day and 2-weeks
14–16	Total	19,863	1,238	6.23	2,248	.11	

TABLE 24—RESULTS OF SPRAYING EXPERIMENTS FOR CONTROL OF PLUM CURCULIO ON APPLE—1925—*Concluded*

EXPERIMENT STATION FARM: DETAILED RECORD—*Concluded*

Tree Nos.	Kind of Fruit	Total No. of Apples	No. Marked by Curculio	Per Cent Marked Fruit	Total No. of Punctures	Average No. Punctures Per Apple	Treatment Received
D 4 and 13	Drops	627	365	58.21	816	1.30	
	Picked	1,818	1,369	75.30	4,559	2.50	Check—no treatment
	Total	2,445	1,734	70.92	5,375	2.19	
E 1–3	Drops	3,556	201	5.65	300	.08	No calyx
5–12	Picked	18,030	1,734	9.61	2,819	.15	Pink; 7-day and 2-wks
14–16	Total	21,586	1,935	8.96	3,119	.14	
E 4 and 13	Drops	1,015	425	41.87	1,112	1.09	
	Picked	2,672	2,039	76.30	6,139	2.29	Check—no treatment
	Total	3,687	2,464	66.82	7,251	1.96	
F 1–3	Drops	9,620	1,629	16.93	2,929	.30	No 7-day
5–12	Picked	22,592	3,268	14.46	6,075	.27	Pink, calyx and 2-wks
14–16	Total	32,212	4,897	15.20	9,004	.27	
F 4 and 13	Drops	2,709	1,130	41.71	2,337	.86	
	Picked	1,635	1,332	81.46	3,640	2.22	Check—no treatment
	Total	4,344	2,462	56.67	5,977	1.37	
A, B, C, D, E, F,	Drops	7,158	4,010	56.02	8,471	1.18	
	Picked	11,919	7,669	64.34	20,182	1.69	Summary of all checks
4 & 13	Total	19,077	11,679	61.22	28,653	1.50	

Total number apples scored 144,435

Note—"Drops" include early drops collected until about the middle of July. "Picked" includes fruit taken from tree and also windfalls at time of harvesting crop.

TABLE 25—SHOWING COMPARISON OF DIFFERENT SPRAY TREATMENTS

EXPERIMENT STATION FARM—1925

	Treatment	Per Cent. Unmarked Fruit	Kind of Fruit	Total Per Cent of Unmarked Fruit
1	*No calyx* Pink, 7-day and 2 weeks	94.35	Drops	91.04
		90.39	Picked	
2	*No calyx*: Pink; 6 days after calyx; 8 days later; 2 weeks after 8 day	61.21	Drops	75.95
		82.24	Picked	
3	*No 7-day* Pink, calyx and 2 weeks	83.07	Drops	84.80
		85.54	Picked	
4	*No 7-day* Pink, calyx with fish oil; 2 weeks	95.60	Drops	93.93
		93.30	Picked	
5	*No 7-day*: Pink—heavy dose lead arsenate at calyx; also at 2 weeks	41.66	Drops	88.33
		91.47	Picked	

TABLE 25—SHOWING COMPARISON OF DIFFERENT SPRAY TREATMENTS —*Concluded*

EXPERIMENT STATION FARM—1925—*Concluded*

		Per Cent Unmarked Fruit	Kind of Fruit	Total Per Cent of Unmarked Fruit
	No 2 weeks	81.20	Drops	
6	Pink, calyx and 7-day	92.33	Picked	89.66
	All sprays	92.08	Drops	
7	Pink, calyx, 7-day and 2 weeks	94.60	Picked	93.77
		43.98	Drops	
8	Check-no spray	35.66	Picked	38.78

Notes:

Percentages based on counts varying from 3,820 to 32,212 apples for each plot.

Early drops collected 1925.

Amount of spray used 8–14 gallons per tree.

All apples scored by individual examinaion.

Orchard cultivated until 1925 when middle section was left in sod.

Spray Formulas Used

Lead arsenate..... 3 pounds
Nicotine sulphate..... 1 pint
Casein lime..... 1 pound
Lime sulphur (dry)..... 6 pounds
Water.....100 gallons

Fish oil (light pressed menhaden)
1 quart
Lead arsenate..... 3 pounds
(No. 4 only at calyx)
Water.....100 gallons

Lead arsenate..... 6 pounds
(No. 5 only at calyx and 2 weeks)
Water.....100 gallons

Dates of Spray Applications

Pink,—April 29. Calyx,—May 19. 6-day,—May 25. 7-day,—May 26. 2-weeks,—June 1 and 2. 4-weeks,—June 16.

RESULTS IN 1926.

Coated lead arsenate was tried with a view to eliminating some of the sprays but without success. It should be said, however, that the material used was not the same as the product manufactured later and probably failed for this reason. Colloidal arsenate of lead was used as a substitute for acid lead arsenate with good results. During 1926, the plots treated with lead arsenate and fish oil at the calyx period fell below the complete schedule by 1.3 per cent. The total score of all trees receiving the treatment, however, fell somewhat below this due to the

high score of one outside tree. This tree seemed to be so much out of line with the results obtained from the rest that it seems justifiable to omit it from the final figures:

TABLE 26—RESULTS OF FISH OIL—LEAD ARSENATE TEST

Tree No.	Total number apples	Number marked by curculio	Size of tree cubic yards	Per cent marked fruit
B1	2,840	705	330	24.8
B2	3,707	231	318	6.2
B3	1,976	78	286	3.9
B5	4,607	227	345	4.9
B6	2,550	90	400	3.5
B7	1,502	52	343	3.5
B8	735	18	278	2.4
Average marked fruit omitting B1.				4.6

TABLE 27—RESULTS OF SPRAYING EXPERIMENTS FOR CONTROL OF PLUM CURCULIO ON APPLE—1927

EXPERIMENT STATION FARM: DETAILED RECORD

Tree Nos.	Total No. of Apples	No. Marked by Curculio	Per Cent Marked Fruit	Total No. of Punctures	Average No. Punctures Per Apple	Treatment Received
A 1–3 5–8	6,670	1,333	19.9	2,474	.37	No 7-day; pink, calyx with regular lead arsenate (no lime sulphur), 2-weeks
A 9–12 14–16	10,988	1,807	16.4	3,797	.34	No 7-day; pink, calyx with coated lead arsenate (no lime sulphur), 2-weeks
A 4 and 13	1,552	1,207	77.1	4,104	2.64	Check—no treatment
B 1–3 5–8	18,267	1,751	9.6	2,872	.16	No 7-day; pink; calyx with fish oil and lead arsenate no lime sulphur; 2-weeks
C 1–3 5–8	23,169	1,672	7.2	3,213	.14	No 7-day; pink; calyx with fish oil and lead arsenate, no lime sulphur
B 4 and C 4	3,221	871	27.0	1,649	.51	Check—no treatment
B 9–12 14–16	4,816	522	10.8	634	.13	No calyx; pink; 4 days after calyx; 5 days later;
C 9–12 14–16	3,093	232	7.5	363	.12	12 days after 5-day (complete mixture)
B 13 C 13	3,181	1,667	52.4	3,575	1.12	Check—no treatment
D 1–3 5–8	5,965	87	1.46	153	.025	Complete schedule; pink (ferrous ars.); 7-day, calyx Colloidal lead ars.; 2-weeks
D 4	1,820	702	38.86	1,333	.73	Check—no treatment
D 9–12 14–16	4,061	136	3.34	286	.07	All sprays; pink; calyx; 7-day; 2-weeks; complete mixture
D 13	398	113	28.4	264	.66	Check—no treatment
E 1–3 4–12 14–16	2,889	143	4.9	389	.13	No pink; calyx; 7-day and 2-weeks; complete mixture
E 4, 13 F 9–12	853	421	49.3	1,235	1.45	Check—no treatment No 7-day; pink; calyx and
14–16	10,664	578	5.4	1,159	.10	2-weeks; complete mixture
F 13	66	59	89.4	342	5.18	Check—no treatment
Checks	11,091	5,040	45.44	12,502	1.12	

Notes—Drop fruits were not collected in this orchard in 1926.

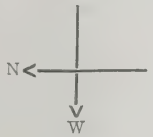
Spray dates: Pink, May 4.
Calyx, May 28
7-day, June 4
2-weeks, June 11
4-weeks, June 24

Formula: Complete mixture and fish oil same as in 1925.
Colloidal and ferrous arsenates at 3 pounds per 100 gallons.
Coated lead arsenate at 8 lbs. paste per 100 gallons.

RESULTS IN 1927

During this year the orchard was divided into three blocks of 24-30 trees each, the plots being sprayed with (1) pink, calyx, 7-day and 2-weeks schedule, (2) pink, calyx, with fish oil and lead arsenate, and 2-weeks sprays, (3) pink, calyx, 2-weeks and 4-weeks sprays. Casein lime was added to plot (2) at the calyx period causing much of the spray to run off the foliage and was thought to be responsible for the poor showing of this plot. The results again showed that the complete schedule (1) was better and on the end row, some 8-15 per cent better than other schedules. The total percentage, however, showed little difference (2-5 per cent), but the considerably improved control of this schedule since 1924 began to be apparent, indicating that the most consistently good results are to be expected from it. A diagram of the orchard with percentages of marked fruit on the count trees is shown below and indicates the variation in percentage of marked fruit in various locations. This year outlying wild apples were sprayed within a fourth of a mile of the orchard.

PLAN AND RESULTS OF EXPERIMENTS AT STATION FARM, MOUNT CARMEL IN 1927



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
F	X	X	11	—	X	34	X	5	—	X	—	X	4	—	X	X
E	X	X	5	7	X	74	X	3	5	X	19	X	3	0	X	X
D	X	X	13	3	X	73	X	2	2	X	44	X	1	6	X	X
C	X	X	—	—	X	—	X	—	2	X	15	X	—	3	X	X
B	X	X	—	8	X	—	X	5	2	X	21	X	0	1	X	X
A	19	15	17	23	—	94	20	15	13	4	24	7	5	5	5	9
	Treatments: pink, calyx, 2 weeks, 4 weeks.					check	pink, calyx with fish oil, 2 weeks.				check	pink, calyx, 7-day, 2 weeks.				

Notes:

All percentages referred to nearest whole number; represent fruit marked by curculios.

Trees left blank bore no fruit or so little that the count was worthless.

All picked fruit from count trees scored.

Outlying wild apple trees sprayed with lead arsenate at calyx period.

Drop fruits not collected in 1927.

Row A next a fence row.

Spray dates: Pink—May 6
Calyx—May 26–7
7 day—June 4
2 weeks—June 9
4 weeks—June 23

Formula:
Lead arsenate..... 3 pounds.
Lime sulphur (dry) ..... 6 pounds.
Casein lime..... 1 pound.
Water.....100 gallons

TABLE 28—RESULTS OF SPRAYING EXPERIMENTS FOR CONTROL OF PLUM CURCULIO ON APPLE—1927

EXPERIMENT STATION FARM: DETAILED RECORD

Tree Nos.	Total No. of Apples	Number Marked by Curculio	Per Cent Marked Fruit	Total No. Punctures	Average No. Punctures Per Apple	Treatment
A 1	962	182	18.9	686	.71	Pink, calyx, 2-weeks, 4-weeks
A 2	1,166	176	15.1	296	.25	
A 3	586	99	16.9	208	.35	
A 4	260	60	23.0	139	.534	
A 5	7	0	0.00	0	.0	
B 3	9	0	0.0	0	.0	
B 4	1,424	112	7.8	169	.12	
D 3	171	22	12.9	55	.32	
D 4	1,014	36	3.5	69	.068	
E 3	2,098	102	4.8	163	.077	
E 4	1,261	86	6.8	198	.15	
F 3, 4	4,512	486	10.8	808	.18	
Total	13,470	1,361	10.1	2,791	.20	
A 7	1,586	321	20.2	667	.42	Pink, calyx (with fish oil), 2-weeks
A 8	2,366	357	15.1	601	.25	
A 9	260	33	12.7	44	.16	
A 10	178	7	3.9	10	.056	
B 8	19	1	5.2	2	.105	
B 9	450	10	2.2	16	.035	
C 9	626	16	2.5	29	.046	
D 8	667	12	1.8	16	.024	
D 9	1,452	35	2.4	52	.035	
E 8	2,792	93	3.3	180	.064	
E 9	2,496	118	4.7	205	.082	
F 8	4,543	238	5.2	382	.084	
Total	17,435	1,241	7.11	2,204	.126	
A 12	2,139	156	7.3	288	.13	Pink, calyx, 7-day, 2-weeks
A 13	218	1	.45	1	.04	
A 14	466	22	4.7	36	.077	
A 15	2,004	97	4.8	114	.056	
A 16	3,855	359	9.3	547	.14	
B 14	167	2	1.2	5	.029	
B 13	50	0	0	0	.0	
C 14	5,890	168	2.8	248	.042	
D 13	626	74	1.2	23	.036	
D 14	2,089	118	5.6	197	.094	
E 13	396	14	3.5	36	.091	
E 14	39	0	0	0	.0	
F 13	3,185	139	4.3	159	.049	
Total	21,124	1,150	5.44	1,654	.078	
A 6	292	274	93.8	1,259	4.30	Check—no treatment
A 11	152	36	23.7	69	.45	
B 11	179	37	20.6	51	.28	
C 11	1,491	221	14.8	343	.23	
D 6	1,056	772	73.1	2,031	1.92	
D 11	809	358	44.2	781	.96	
E 6	916	682	74.4	1,869	2.04	
E 11	1,461	276	18.9	412	.28	
F 6	1,860	641	34.4	1,200	.64	
Total	8,216	3,297	40.13	8,015	.97	

RESULTS IN 1928

The same plots were used in 1928 as in 1927, but with one different treatment; namely, a pink, calyx, 10-day, and 20-day schedule. There appeared to be little difference in any of the plots, indicating that they were about equal in curculio control. The pink, calyx, 7-day and two-weeks spray and the pink, calyx, 10-day and 20-day sprays, gave more uniform control. A comparison of several trees of the same variety and the same relative location in the orchard on the other hand, indicates a slight but not significant advantage for the schedule containing fish oil over that omitting it, Table 29. Wild apples in the vicinity of the orchard were sprayed again.

TABLE 29

Variety	Tree No.	Total Apples	Height in Feet	Size cu. yds.	Per cent marked	Treatment
Baldwin	A2	2,179	20	277	13.3	Pink, calyx, 7-day, 2 weeks.
"	A13	2,811	19	274	5.1	pink, calyx with fish oil, 2 weeks.
"	A4	2,294	20	318	8.3	pink, calyx, 7-day 2 weeks.
"	A12	2,125	21	309	7.1	pink, calyx with fish oil, 2 weeks.
Greening	D4	1,318	20	310	7.7	pink, calyx, 7 day, 2 weeks.
"	D13	1,419	19	310	2.1	pink, calyx with fish oil, 2 weeks.
"	D3	1,417	18	233	4.3	pink, calyx 7-day, 2 weeks.
"	D14	1,325	18	312	5.0	pink, calyx with fish oil, 2 weeks.

The total percentage of marked fruit is almost identical on the outside row in the different plots and further indicates that the amount of control was almost the same in all three while mathematical computations indicate no significant advantage of any schedule. This year was a bad year for russeted fruit and scab. No McIntosh trees received the fish oil-lead arsenate spray in 1928, but it is reasonable to expect decreased control of scab when such schedules are used. On trees not scabbing badly results were good, the foliage being better and with less spray burn, due no doubt to decreased amount of spray. Advantages of this schedule lie in its greater economy since one application is omitted, and its greater safety—probable disadvantages in lessened fungous control.

A comparison was also made in 1928 of 90-10 sulphur arsenate dust and spray, both dust and spray being applied on the same schedules—pink, calyx, 7-day and 2-weeks. Results indicate a slightly better control of curculio by spraying although the differ-

ence is not great. Thus the per cent of unmarked fruit in the sprayed plot for this year totaled 96.6 per cent while the unmarked fruit on the dusted plot totaled 92.7 per cent. This corresponds in general with results obtained in the Milford experiments of Zappe and Stoddard.

PLAN AND RESULTS OF EXPERIMENTS TO CONTROL CURCULIOS AT EXPERIMENT STATION FARM IN 1928

	1	2	3	4	5	6	6	8	8	10	11	12	13	14	15	16
F	X	X	2.8	1.7	45	X	X	4.3	3.2	X	X	28	25	2.2	X	X
E	X	X	3.1	4.9	X	20	X	3.5	—	X	9.5	3.1	1.4	1.0	X	X
D	X	X	4.3	7.7	X	33	X	6.0	2.7	X	27	X	2.1	5.0	X	X
C	X	X	3.2	2.2	X	11	X	1.4	3.0	X	22	X	3.5	—	X	X
B	X	X	4.6	5.2	X	9	X	2.3	3.8	X	12	X	4.8	7.4	X	X
A	6.4	13.3	11.7	8.3	9.2	30	8.0	10.7	7.1	10.2	33	7.1	5.1	6.3	17.0	—
Treatments:	pink, calyx, 7 day, 2 weeks.					check	pink, calyx, 10 day, 20-day.				check		pink, calyx with fish oil, 2 weeks.			

Notes:

Outlying wild apple trees sprayed with lead arsenate and fish oil sticker at calyx period. No drop fruits collected.

Spray dates: pink—May 8
Calyx—May 28
7-day—June 4
10-day—June 7
2-weeks—June 11
20 day—June 18

Formula—
Lead arsenate..... 3 pounds
Lime sulphur (dry)..... 6 pounds
Casein lime..... 1 pound
Water.....100 gallons
Fish oil, 1 pint to 100 gallons. (Used in combination with lead arsenate only.)

TABLE 30—RESULTS OF SPRAYING EXPERIMENTS FOR CONTROL OF PLUM CURCULIO ON APPLES

EXPERIMENT STATION FARM—1928

	Total No. of Apples	Number Marked by Curculio	Per Cent Marked Fruit	Total[1] Number Punctures	Average No. Punctures Per Apple	Treatment
A 1	235	15	6.4	36	.15	Pink, calyx, 7-day, 2-weeks
A 2	2,179	290	13.3	450	.21	
A 3	844	99	11.7	136	.16	
A 4	2,294	191	8.3	288	.12	
A 5	3,971	366	9.2	521	.13	
B 3	3,083	143	4.6	186	.06	
B 4	2,308	120	5.2	177	.08	
C 3	3,175	103	3.2	132	.04	
C 4	2,811	61	2.2	73	.02	
D 3	1,417	61	4.3	69	.05	
D 4	1,318	101	7.7	177	.13	
E 3	1,001	31	3.1	52	.05	
E 4	896	44	4.9	66	.07	
F 3	3,914	109	2.8	111	.03	
F 4	2,740	47	1.7	57	.02	
Totals	32,186	1,781	5.53±1.95	2,531	.079	
A 7	4,075	327	8.0	448	.11	Pink, calyx, 10-day, 20-day
A 8	2,747	293	10.7	341	.12	
A 9	3,952	281	7.1	356	.09	
A 10	1,859	189	10.2	275	.15	
B 8	1,699	40	2.3	96	.06	
B 9	2,360	91	3.8	138	.06	
C 8	944	13	1.4	21	.02	
C 9	708	21	3.0	28	.04	
D 8	1,171	70	6.0	112	.09	
D 9	1,498	41	2.7	51	.03	
E 8	676	24	3.5	24	.03	
F 8	234	10	4.3	3	.01	
F 9	3,676	120	3.2	137	.04	
Totals	25,599	1,520	5.93±2.29	2,030	.079	
A 12	2,125	153	7.1	237	.11	Pink, calyx with fish oil, 2-weeks
A 13	2,811	144	5.1	209	.07	
A 14	3,613	228	6.3	295	.08	
A 15	2,233	379	17.0	617	.27	
B 13	2,218	106	4.8	146	.06	
B 14	1,055	78	7.4	128	.12	
C 13	3,204	112	3.5	138	.04	
D 13	1,419	30	2.1	40	.03	
D 14	1,325	67	5.0	100	.07	
E 12	3,185	98	3.1	133	.04	
E 13	1,258	18	1.4	12	.009	
E 14	695	7	1.0	6	.009	
F 13	479	120	25.0	167	.35	
F 14	1,400	31	2.2	47	.03	
Totals	27,020	1,571	5.81±1.87	2,275	.084	
A 6	1,003	302	30.1	602	.60	Check—no treatment
B 6	1,447	130	9.0	170	.12	
C 6	1,690	183	10.8	222	.13	
D 6	1,580	515	32.6	864	.55	
E 6	840	168	20.0	294	.35	
F 5	352	158	44.9	279	.79	
A 11	2,450	818	33.4	1,326	.54	
B 11	2,291	285	12.4	429	.19	
C 11	1,126	242	21.5	393	.35	
D 11	995	255	25.6	495	.50	
E 11	1,149	109	9.5	124	.11	
F 12	3,152	873	27.7	1,235	.39	
Totals	18,075	4,038	22.26±2.28	6,433	.356	

[1] Does not include fall feeding punctures.

TABLE 31—EXPERIMENTS TO CONTROL THE PLUM CURCULIO ON APPLE: SPRAY VERSUS DUST

Tree	Total Apples	Number Marked by Curculio	Per Cent Marked Fruit	Total Number of Punctures	Average Number Punctures Per Apple	Treatment
N 3	380	119	31.3	179	.47	Spray: pink, calyx, 7-day, 2-weeks
N 4	432	60	13.9	87	.20	
N 6	4,042	121	3.0	156	.4	
N 7	2,236	9	.4	8	.003	
N 8	2,034	30	1.4	45	.02	
N 9	1,118	0	0	0	.0	
Totals	10,242	339	3.3±3.3	475	.046	
R 5	1,983	181	9.1	272	.14	Dust: pink, calyx, 7-day, 2-weeks
R 6	896	57	6.4	82	.09	
R 7	1,993	90	4.5	91	.04	
R 8	891	70	7.8	101	.11	
R 9	2,469	127	5.1	143	.06	
S 7	513	6	1.2	6	.01	
S 8	1,242	40	3.2	62	.05	
S 9	3,994	259	6.5	323	.08	
Totals	13,981	830	5.9±1.6	1,070	.076	
N 2	1,068	525	49.2	1,302	.122	Check—no treatment
O 1	202	96	47.5	216	.107	
Totals	1,270	621	48.89	1,518	.119	

EXPERIMENTS AT SHEPARD'S ORCHARD, MOUNT CARMEL; RESULTS IN 1925

This orchard consists of 52 trees of three varieties arranged in six rows. It was divided into two plots with check row through the center. The orchard is provided with abundant sources of infestation, with sprayed and unsprayed apple trees on three sides and a bearing peach orchard on the fourth. In 1925, it received (1) a pink, calyx, 7-day and 2-weeks schedule and (2) a pink, calyx, 2-weeks and five weeks spray. Results favored the condensed schedule (1) by nearly seven per cent.

TABLE 32—RESULTS OF SPRAYING EXPERIMENTS TO CONTROL CURCULIOS: SHEPARD'S ORCHARD—1925

Total Apples	Total Injured	Per Cent Injured	Total Punctures	Average No. Punctures Per Apple	Kind of Fruit Scored	Treatment
						7-day
421	113	26.84	266	.63	Drops	April 29, May 19
11,071	2,295	20.73	4,718	.43	Picked	May 27, June 2
11,492	2,408	20.95	4,984	.43	Total	
						5-weeks
421	113	26.84	266	.63	Drops	April 29, May 19
12,352	3,389	27.43	7,616	.62	Picked	June 2, June 22
12,773	3,502	27.41	7,882	.62	Total	
625	534	85.44	1,574	2.52	Drops	Check—no treatment
3,040	2,369	77.92	8,121	2.67	Picked	
3,665	2,903	79.20	9,695	2.64	Total	

TABLE 33—COMPARISON OF SPRAYS FOR CURCULIO CONTROL: SHEPARD'S ORCHARD—1925

Treatment	Per Cent Unmarked Fruit	Kind of Fruit	Total Per Cent of Unmarked Fruit
7-day	73.26	Drops	
April 29, May 19			79.05
May 27, June 2	79.27	Picked	
5-weeks	73.16	Drops	
April 29, May 19,			72.59
June 2, June 22	72.57	Picked	
Check	14.56	Drops	
No Treatment			20.80
	23.08	Picked	

Notes:

Trees planted in 1911.

Amount of spray used 5–7 gallons per tree. (Trees bearing most fruit smaller than trees at Experiment Station farm.)

Percentages based on counts varying from 3,665 to 12,773 apples for each plot.

This orchard is very heavily infested; has been in sod, but was sprayed regularly by owner in previous years. Cultivated in part during 1925.

Spray Formula Used.

Lead arsenate	3 pounds
Nicotine sulphate	1 pint
Casein lime	1 pound
Lime sulphur (dry)	6 pounds
Water	100 gallons

RESULTS IN 1926

The two plots were reversed during 1926 and were the same except that schedule Number 2 received a 4-weeks after calyx application instead of a 5-weeks. This year the condensed schedule averaged .5 per cent less than the expanded pink-calyx-2-weeks-4-weeks schedule.

RESULTS IN 1927

Thinking that our 1926 results might have been influenced unduly by some unseen factor the same sprays were repeated on the same plots with the result that the expanded schedule averaged .1 per cent better. The amount of fruit on the two plots was slightly larger both years on the plot receiving the condensed schedule and if influenced by this factor alone the count should have been much better. The systematic increase in injury occurs on the orchard fringe but is greater towards the west side and should influence both plots alike. This infestation is apparently

TABLE 34—RESULTS OF SPRAYING EXPERIMENTS FOR CONTROL OF PLUM CURCULIO: SHEPARD'S ORCHARD—1926

Row	Kind of Fruit	Total No. of Apples	Number Marked by Curculio	Per Cent Marked Fruit	Total No. of Punctures	Average No. Punctures Per Apple	Treatment
C 1–4	Drops	2,243	100	4.4	147	.065	Pink, calyx, 7-day and 2-weeks
	Picked	9,325	339	3.6	540	.058	
D 1–4	Drops	5,321	373	7.01	626	.117	
	Picked	10,752	306	2.8	504	.0468	
E 1–4	Drops	3,110	151	4.8	286	.0919	
	Picked	5,681	91	1.6	196	.034	
F 1–4	Drops	2,403	85	3.5	121	.050	
	Picked	8,553	196	2.26	295	.034	
G 1–4	Drops	583	26	4.4	37	.063	
	Picked	3,792	75	1.97	105	.027	
H 1–4	Drops	925	95	10.2	155	.167	
	Picked	2,223	93	4.2	303	.136	
Total	Drops	14,585	830	5.69	1,372	.094	
	Picked	40,326	1,100	2.73	1,943	.048	
Total all fruits		54,911	1,930	3.51	3,315	.060	
C 6–7	Drops	1,261	84	6.6	122	.09	Pink, calyx, 2-weeks and 4-weeks
	Picked	4,546	200	4.4	292	.06	
D 6–8	Drops	2,193	96	4.4	263	.12	
	Picked	6,731	86	1.2	115	.02	
E 6–9	Drops	1,383	190	13.9	360	.26	
	Picked	6,266	148	2.3	254	.04	
F 6–9	Drops	310	9	2.9	14	.04	
	Picked	1,624	33	2.0	66	.04	
G 6–8	Drops	262	13	4.9	18	.07	
	Picked	2,719	129	4.7	231	.08	
H 6–10	Drops	1,127	158	14.0	240	.21	
	Picked	2,239	183	8.2	406	.18	
Total	Drops	6,536	550	8.41	1,017	.15	
	Picked	24,125	779	3.22	1,364	.05	
Total all fruits		30,661	1,329	4.334	2,381	077	
Total CDEFG 5	Drops	3,177	1,398	44.0	2,781	.87	Check—no treatment
	Picked	8,036	2,144	26.7	4,444	.55	
Total all fruits		11,213	3 542	31.58	7 225	.644	

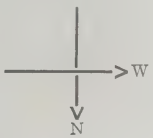
somewhat worse, however, on the northwest corner which falls within the plot receiving the condensed schedule. The only other factor entering the question is the size of the trees. These were measured and it was found that those receiving the condensed schedule are larger. From these facts it becomes apparent that although the count is almost identical, that plot receiving the condensed schedule is in reality better because it controlled equally well with a greater handicap.

TABLE 35—RESULTS OF SPRAYING EXPERIMENTS FOR CONTROL OF PLUM CURCULIO ON APPLE; SHEPARD'S ORCHARD—1927

Tree Nos.	Total No. of Apples	Number Marked by Curculio	Per Cent Marked Fruit	Total No. of Punctures	Average No. Punctures Per Apple	Treatment
D 3	703	23	3.27	36	.051	Pink, calyx, 7-day, 2-weeks
E 3	19	0	0.0	0	.0	
F 3	1,236	38	3.0	56	.045	
G 3	836	38	4.5	66	.079	
H 2	746	160	21.45	361	.484	
D 4	223	7	3.1	9	.040	
E 4	95	1	1.05	2	.021	
F 4	1,645	46	2.8	59	.036	
G 4	868	4	.46	11	.012	
H 4	782	49	6.26	207	.264	
Totals	7,153	366	5.1	807	.112	
D 6	210	3	1.4	3	.014	Pink, calyx, 2-weeks, 4-weeks
E 6	121	2	1.65	2	.016	
F 6	964	55	5.7	117	.121	
G 6	157	99	6.3	94	.598	
H 6	1,704	100	5.86	161	.094	
E 7	346	9	2.6	9	.026	
F 7	1,441	16	1.1	24	.016	
G 7	1,924	42	2.2	64	.033	
H 7	1,308	81	6.2	106	.081	
Totals	8,175	407	4.98	580	.071	
D 5, E 5 F 5, G 5, H 5	1,566	628	40.1	1,073	.68	Check—no treatment

Note—Drop fruits were not collected in this orchard in 1927.

PLAN AND RESULTS OF EXPERIMENTAL WORK IN SHEPARD'S ORCHARD —1927



	A	B	C	D	E	F	G	H	
1	X	X	X	X	X	X	X	X	Pink, calyx, 7-day, 2 weeks.
2			X	X	X	X	X	21	
3			..	3	0	3	4	..	
4			..	3	1	3	.4	6	
5			..	11	26	39	51	55	Check—no treatment.
6			..	1	2	5	8	6	
7			..	..	3	1	2	6	Pink, calyx, 2-weeks, 4-weeks.
8			X	X	X	X	X	X	
9					X	X	X	X	
10								X	

Notes:

Figures represent percentages of curculio marked fruit. All percentages are referred to the nearest whole number.

All picked fruit from count trees scored.

Trees left blank bore no fruit in 1927.

Spray dates—pink May 6–7
calyx—May 27
7-day—June 4
2-weeks—June 9
4-weeks—June 23

Formula—
Lead arsenate..... 3 pounds
Lime sulphur (dry)..... 6 pounds
Casein lime..... 1 pound
Water.....100 gallons

RESULTS IN 1928

This year the complete condensed schedule (pink, calyx, 7-day and 2-weeks) was retained on the same plot and compared with the same schedule on the remaining plot, varying only in the substitution of basic lead arsenate for the acid form commonly employed. The basic arsenate apparently reduced the amount of russet on Gravensteins by seven per cent, but did not so affect the McIntosh. On the other hand, canker worms did much more damage in this plot and the total percentage of fruit unmarked by curculio was considerably less—90.9 per cent compared with 94.3 per cent for the acid lead arsenate.

TABLE 36—EXPERIMENTS IN CURCULIO CONTROL; SHEPARD'S ORCHARD—1928

Tree Nos.	Total No. of Apples	Number Marked by Curculio	Per Cent Marked Fruit	Total No. of Punctures	Average No. Punctures Per Apple	Treatment
C 3	2,749	211	7.67	286	.10	Pink, calyx, 7-day, 2 weeks (acid lead arsenate)
D 3	3,148	37	9.8	37	.01	
E 3	4,211	118	2.8	141	.03	
F 3	1,795	20	1.1	24	.01	
G 3	1,182	87	7.36	133	.11	
H 2	1,203	254	21.1	470	.39	
C 4	2,154	216	10.0	328	.15	
D 4	2,528	53	2.1	62	.02	
E 4	2,789	93	3.3	131	.05	
F 4	1,978	88	4.4	129	.06	
G 4	1,421	89	6.3	127	.09	
H 4	800	220	27.5	409	.51	
Totals	25,958	1,480	5.7	2,277	.8	
C 6	1,741	351	20.2	488	.28	Pink, calyx, 7-day and 2-weeks (basic lead arsenate)
D 6	2,140	60	2.8	75	.03	
E 6	2,792	178	6.4	270	.09	
F 6	565	27	4.8	35	.06	
G 6	649	51	7.9	73	.01	
H 6	1,210	289	23.88	434	.36	
C 7	1,894	385	20.32	212	.11	
D 7	3,983	82	2.1	111	.03	
E 7	2,617	109	4.2	147	.05	
F 7	164	13	7.9	18	.11	
G 7	825	31	3.8	42	.05	
H 7	780	183	23.5	294	.37	
Totals	19,360	1,759	9.18	2,199	.11	
$C_6D_6E_6F_6$	4,848	1,435	29.6	2,211	.45	Check, no treatment

PLAN OF EXPERIMENTS AT SHEPARDS ORCHARD, 1928: AND RESULTS OF FRUIT COUNTS FROM DIFFERENT TREES

A	B	C	D	E	F	G	H		
X	X	X	X	X	X	X	X	1	Pink, calyx, 7 day, 2 weeks.
		X	X	X	X	X	21.1	2	Acid lead arsenate.
		7.6	9.8	2.8	1.1	7.3	..	3	
		10.0	2.1	3.3	4.4	6.3	27.15	4	
		4.15	2.21	2.22	56.1	..	..	5	Check—no treatment.
		20.2	2.8	6.4	4.8	7.9	23.9	6	
		20.3	2.1	4.2	7.9	3.8	23.5	7	Pink, calyx, 7-day, 2 weeks.
		X	X	X	X	X	X	8	Basic lead arsenate.
			X	X	X	X	X	9	
							X	10	

Spray dates—Pink—May 10
Calyx—May 24
7-day—May 31
2-weeks—June 7

Formula same as used in Experiment Station Orchard, except for addition of nicotine sulphate at pink and calyx periods.

Assembled Results of Different Sprays for Curculio Control—1924–1928

The following table gives a general summary of the work with sprays conducted between 1924 and 1928 with percentages of fruit unmarked by curculios obtained in the different experiments. Treatments 1-8 were conducted in the orchard of the Experiment Station at Mount Carmel, 9-11 in the orchard of Mr. C. E. Shepard near Mount Carmel. The assembled results show the importance of the 7-day treatment, and the close similarity of the schedule containing fish oil sticker. The unusual uniformity of results obtained in 1928 is probably accidental, but shows that the various schedules employed are about equal in effectiveness; and we believe all of them have considerable merit for control of curculios under Connecticut conditions.

Table 37—Results of Different Sprays for Curculio Control 1924–1928—Picked Fruit Only

	Treatment	Per Cent Clean Fruit				
		1924	1925	1926	1927	1928
1	*No pink* Calyx, 7-day, 2-weeks...	83.9	....	95.04	....	....
2	*No calyx* Pink, 7-day, 2-weeks....	82.5	90.4	....	....	....
3	*No 7-day* Pink, calyx, 2-weeks....	85.6	85.54	94.6	....	....
4	*No 7-day* Pink, calyx, 2-weeks, 4-weeks.....	....	....	....	89.9	....
5	*No 2-weeks spray* Pink, calyx and 7-day...	88.8	92.3	....	....	....
6	Pink, calyx, 10-day, 20-day	....	....	....	....	94.07
7	*All sprays* Pink, calyx, 7-day, 2-weeks	90.7	94.6	96.65	94.6	94.4
8	*No 7-day* Fish oil plus lead arsenate at calyx; pink, calyx and 2-weeks.....	....	93.30	95.3	92.9	94.19
9	*5-weeks spray* Pink, calyx, 2-weeks, 5-weeks.....	....	72.5	....	....	....
10	*4-weeks spray* Pink, calyx, 2-weeks, 4-weeks.....	....	....	96.78	95.02	....
11	*All sprays* Pink, calyx, 7-day, 2-weeks	....	79.2	97.26	94.9	94.4

Miscellaneous Results

During the experiments conducted at the Experiment Station Farm, it was noted that a gradual reduction in curculio injury took place over that five-year period when the tests were conducted. The following figures are the average of marked fruit obtained from the check trees:

Table 38

Date	Per Cent Marked by Curculio	Notes
1924	64	Drops collected
1925	61	" "
1926	45	" "
1927	40	Wild apples sprayed
1928	22	" "

It seems that continued sprays of the kind employed,together with supplementary controls such as removal of drop fruits (1924-6) and spraying of outlying trees (1927-8) has considerable effect in reducing the total infestation. Also that several years of intensive work results in a steady decline in the total number of curculios in the orchard. It seems reasonable that after a point is reached, similar to 1928, in our spray experiments, that some of the sprays could be safely omitted without seriously influencing the amount of unmarked fruit. The orchardist should then be concerned chiefly with the outside trees of his orchard or the rows nearest the protecting woods if such woods are present.

Cost of Materials

The question will naturally arise as to whether the gain from one extra spray, in decreased amount of curculio damage will pay the cost of the treatment.

Figuring on a cost of materials plus labor employed, and on the basis of our 1928 results it would require at least a five per cent gain in unmarked fruit to pay the cost of the treatment where fruit sells for 12 dollars a barrel, the general market quotation for the highest grade in 1928 (Nov. 25 quotation $2-$12). Where the value of the crop drops to $6 a barrel or $2, a much higher per cent of gain from curculio must be obtained if the cost of the operation is successfully met from this gain. The greatest differences between a three and a four spray schedule, except on outside rows, has not been over 10 per cent in any year, so that the increased value of the crop does not meet the cost of the application in uninjured fruit except for apples bringing the highest price.

The gain in value of clean fruit may be further offset by the practise of including apples marked by curculios (one to three external marks per fruit) in the higher grades (Grade A)—so that

although marked by such punctures the fruit still has considerable value on the market. We have allowed for this condition and assumed for convenience that this fruit will bring 75 per cent of the value of the highest grades although it may and often does bring a much higher per cent.

Regarding the schedule including fish oil sticker it may be stated that although more economical than the other schedules, because of (1) omission of lime sulphur at calyx period, (2) omission of the 7-day application altogether, it cannot be said to control scab except on varieties not especially susceptible. It has, however, been used successfully on Baldwins, Spys, Gravensteins, Wealthys, Suttons, Hurlburts, Greenings and Starks. It may also be added that the European red mite did not become abundant on any of the varieties mentioned during the years when this schedule was used.

Spray Burn

Spray burn being of considerable popular interest at this time, the basic form of lead arsenate was used as noted above in Shepard's orchard. Little or no difference could be seen in the foliage of Gravensteins, Astrachans, or McIntosh, although Gravensteins showed seven per cent less russeted fruit than was present in the plot where acid lead arsenate was used. It is not altogether certain, however, that this difference was due to the spray employed. In our Mount Carmel orchard, the plot where fish oil and lead arsenate were used at the calyx period showed much better foliage than either of the other two spray tests. There was considerable russeted fruit throughout the orchard, most of which was probably due to factors not associated with the spray program.

Arsenical Residue

Analyses of apples sprayed with various combinations were made in 1928, from plots receiving the four-spray schedule, and the three-spray schedule including fish oil sticker at calyx. The latter block contained one Astrachan tree which was picked about August 10. Analysis by Mr. Fisher of the Department of Chemistry, showed .004 grains As_2O_3 per pound of fruit taken from the side of this tree and .006 grains per pound from the top. The tolerance for export fruit is .01 grain arsenic trioxide per pound which is much above that found by Mr. Fisher. Rainfall during July and August averages about four inches per year for each of these months in this locality, but in 1928 the precipitation in July was more than seven inches. Analyses of fruit picked later in the season and also from trees receiving an arsenical spray the tenth of July in addition to the usual schedule (pink, calyx, 7-day and 2-weeks) showed similarly small quantities of arsenical residue, all of them much below the export tolerance. From this it seems that

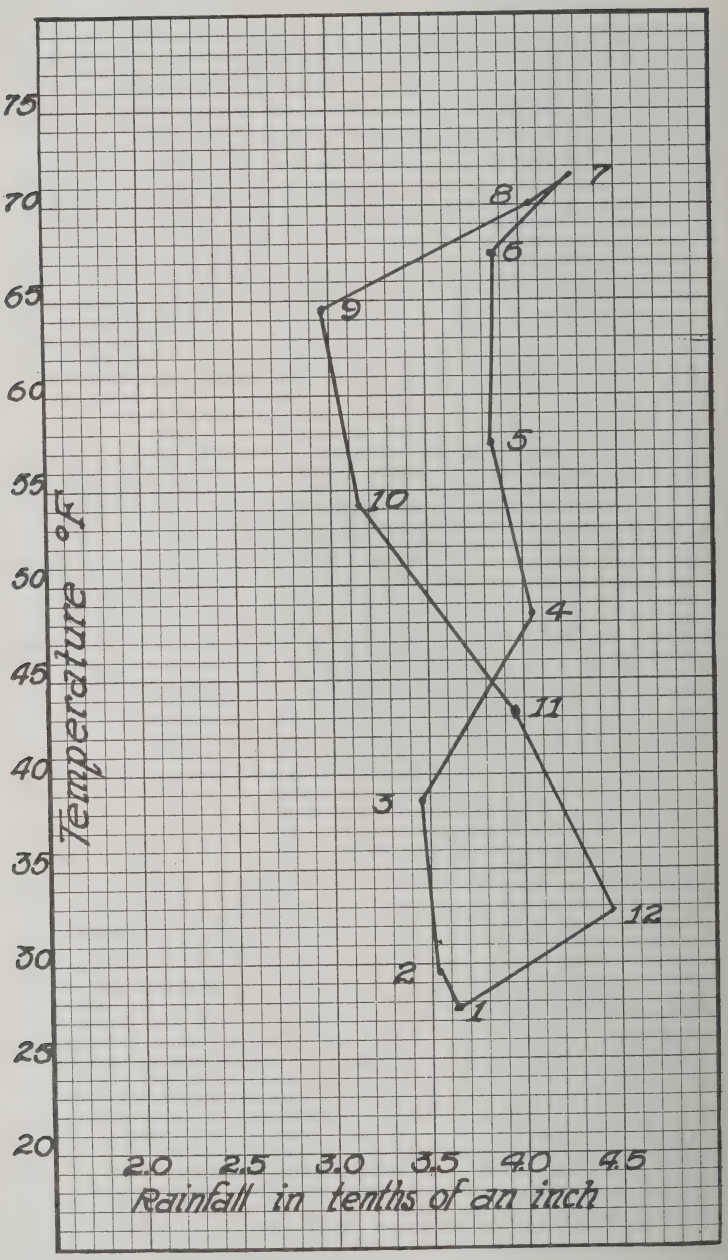


FIG. 32. Climatograph of New Haven district, compiled from U. S. weather bureau records covering the period between 1920 and 1927. The numbers 1, 2, 3, etc., represent the months January, February, March, etc.

there is little danger of harmful residues in Connecticut, especially on those apples picked after September 1, when normally eight or more inches of rain will have fallen. This is also illustrated in Fig. 32 which is a climatograph of the period between 1920 and 1927.

GENERAL CONCLUSIONS

(1) The plum curculio is responsible for much damage to apples in Connecticut.

(2) It is single-brooded and all attempts to produce eggs from beetles emerging during the summer, failed.

(3) The beetles emerge from hibernation near the first of May but do not appear in numbers on the trees till after the blossoms fall.

(4) Beetles come to the trees from outside sources in greatest numbers for a period of about 20 days in Connecticut.

(5) The peak of abundance and egglaying is reached near the middle of June, frequently the 15th, sometimes nearer the 20th.

(6) Beetles developing in dropped apples may offer a serious menace to the succeeding crop.

(7) Sprays applied according to successful schedules outlined in this paper pile up the poison until the June peak of abundance is reached after which there is considerably less danger.

(8) Beetles continue on the trees (apples) in small numbers until the last of July.

(9) All attracting and repelling substances thus far have failed to exert any influence on the curculio in the field. Capryl alcohol is a powerful repellent when confined in cages.

(10) Laboratory tests indicate that the beetles are fond of sweets and may be poisoned in captivity by mixtures containing them.

(11) Effective poisons used in cage tests include, (1) acid lead arsenate, (2) basic lead arsenate, (3) sulphur arsenate dust 90-10, (4) calcium arsenate (5) ortho-zinc arsenite, and (6) sodium fluosilicate lime dust, 1-4.

(12) Parasites are not abundant in Connecticut, the most numerous being apparently *Triaspis curculionis*, which, however, did not kill over 33 per cent of the larvae obtained at any one time.

(13) Spray tests in three different orchards indicate:

(1) That a fair degree of control may be secured with three sprays in Connecticut, but better control with four using a pink, calyx, 7-day and 2-weeks schedule as outlined.

(2) That occasionally a pink, calyx, 2-weeks, and 4-weeks schedule will give good control, while the omission of the 7-day and using fish oil and lead arsenate at the calyx period without lime sulphur closely approximates the results obtained with the four spray schedule but is on the whole less uniform. Such a

schedule should be valuable on trees that burn easily and are not subject to scab infection, besides being more economical than a 4-spray schedule.

(3) That the most consistently good results have been obtained with the 4-spray schedule consisting of pink, 7-day and 2-weeks applications. This resulted in an average of 94.2 per cent unmarked fruit for all tests.

(4) There has been a gradual reduction in injured fruit since 1924, in the orchard where dropped fruits were collected and wild apples in the vicinity sprayed.

(5) Basic lead arsenate compared with acid lead arsenate and used at the same rate per gallon gave less control of curculio than the acid form. It also allowed too much damage from canker worms to be practical at the rate used.

(6) Sprays and dusts used in one field test in 1928 on a full schedule (pink, calyx, 7-day, and 2-weeks) showed the spray slightly superior in control but that dust has merit. This conforms in general with the Milford experiments of Stoddard and Zappe.

(7) Spray residues remaining on the fruit at harvest have been small enough in all cases to conform with the export tolerance.

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The authors gratefully acknowledge all help received during the course of these investigations. The faithful help of those men, including Messrs. T. F. Cronin, A. E. Warren, J. L. Rogers, G. T. Thompson and J. F. Townsend, who did much of the laborious and tiresome portions of the work is hereby acknowledged. We are especially indebted to Mr. E. M. Stoddard, and Mr. C. E. Shepard for use of orchards in which the work was done; to Mr. B. H. Walden who prepared the plates, and to Dr. W. E. Britton, who provided the necessary incentive and encouragement as well as important criticism of the manuscript as finally prepared.

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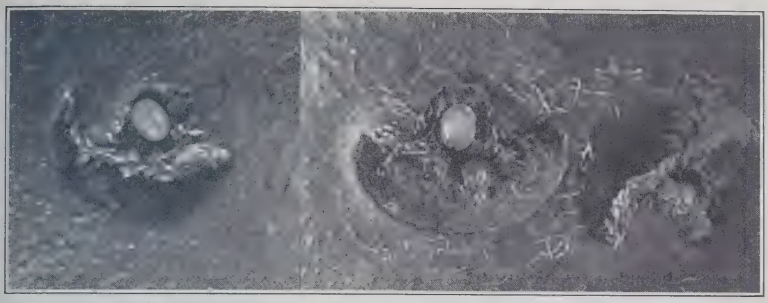
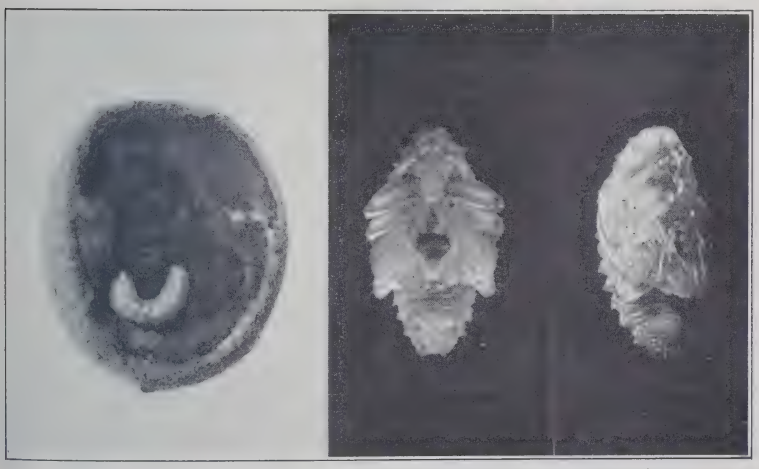


a. The plum curculio egg and crescent shaped egg scars, enlarged nine times.

b. The four larval instars of the curculio, about three times natural size.

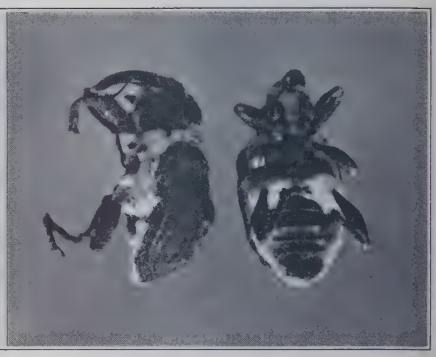


c. Full grown larva in peach, natural size.

d. The pupa, enlarged about five times.

PLATE II

a. The adult beetle curculio, enlarged six times.



b. Beetles attacked by a fungus, *Isaria* sp.

c. The adult beetle and its work on cherries, twice enlarged.

d. The head and beak of the adult curculio, enlarged about 20 times.

a. Jarring beetles from cherry trees in full bloom. Few or no beetles were found at this period.

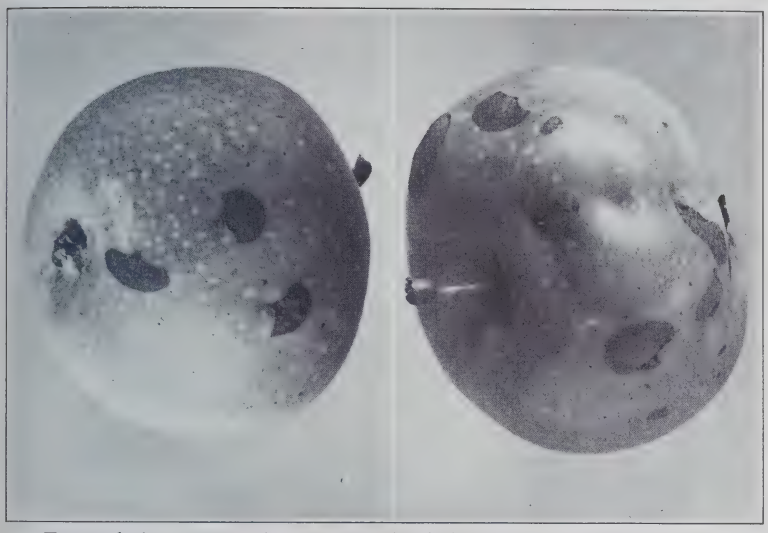
b. Feeding of adult beetles on apple blossoms.

PLATE IV

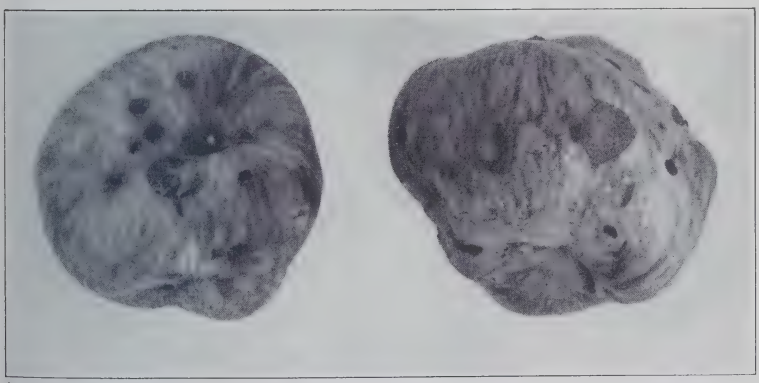
a. Egg scar on apple, enlarged twice.

b. Result of numerous feeding punctures.

c. Size of dropped apples in which curculio larvae frequently develop. Slightly reduced.

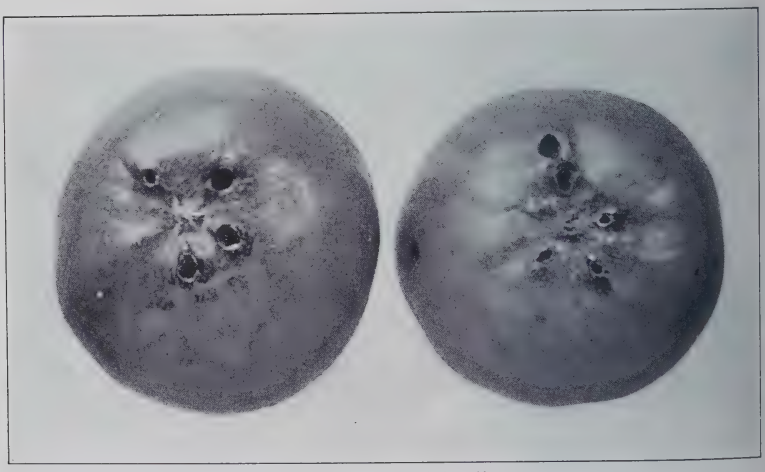


a. Expanded egg scars due to growth of the apple. The eggs or larvae were probably crushed by the growth of the fruit.

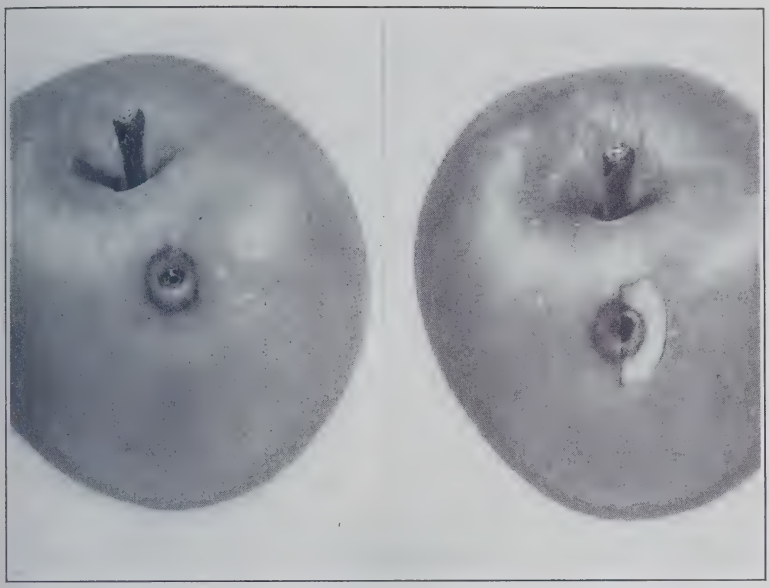


b. Deformed fruit resulting from numerous curculio egg scars and feeding punctures.

a. Fall feeding punctures of beetles emerging during the summer.



b. A common type of fall feeding puncture.



a. Fall feeding puncture cut away to show how puncture is excavated around the edges.

b. Wild apple tree growing under ideal conditions to promote development of curculios in large numbers. A decided menace if near a commercial orchard.

a. Type of spray nozzle used in some of our experiments. There is a graduated hole through the center of the nozzle which furnishes liquid to the spiral surface.

b. Delivery of spray from the nozzle shown in a. Note the solid cone-shaped whirling spray which covers the tree with great rapidity. Absence of projections on the end of the spray rod to catch on branches is a decided advantage. It can be thrust into the center of a tree covering parts not ordinarily reached with the usual spray outfit.

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Connecticut Agricultural Experiment Station
New Haven, Connecticut

THE WILLOW SCAB FUNGUS

Fusicladium saliciperdum

G. P. Clinton
and
Florence A. McCormick

The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to other applicants as far as the editions permit.

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The Willow Scab Fungus

*Fusicladium saliciperdum**

G. P. Clinton and Florence A. McCormick

Introduction

The scab fungus of willows has been known in Europe for many years. In its parasitic stage it was found in North America for the first time in 1927 by the senior author (20). Years before, however, it had been reported, in what is claimed to be its saprophytic stage, from Greenland and Ellesmere Island by Rostrup (48). It is a relative of the common apple and pear scabs and has been called willow scab in Europe but its action on its most susceptible hosts has been so different from that of these scabs that the name willow leaf rot is more descriptive of its injury. It is the imperfect or conidial stage *Fusicladium saliciperdum* that, as a parasite, causes the injury to the willows while the asco or perfect stage occurs on the old dead leaves as a saprophyte only.

We have no fixed opinion whether this disease is native or has been introduced. The fact that it is very closely related to the poplar scab, which is native and has been known for years but which in 1928 assumed unusual vigor, might indicate it is also a native disease that, because of very favorable conditions, has suddenly sprung into unusual prominence from which it may subside, as it does in Europe.

On the other hand, while found here on wild willows, it seems to be confined, so far as seen by us, to the general vicinity where serious outbreaks have occurred on willows planted as shade trees. This might indicate its introduction on foreign stock planted in some of these infected regions, as has been claimed by some.

The willow disease must not be confused with the injury of willow-leaf beetles whose larvæ cause serious damage to the leaves by eating out holes, often skeletonizing them completely.

*We are indebted for aid in obtaining data of various kinds for this paper to Messrs. E. M. Stoddard, A. D. McDonnell, A. A. Dunlap and Mrs. Lillian D. Kelsey, of the Botanical Department. Specimens of diseased willows, collected both within and outside the state, have been sent by a number of interested people. Permission was granted by Luther M. Keith of the State Highway Department to spray street trees and by Mr. and Mrs. Henry F. Parmelee, to spray trees on their estate; both at Norfolk, Conn. Alfred Rehder, of the Arnold Arboretum, has verified many of our willow determinations. Dr. C. W. Dodge, of the Farlow Cryptogamic Herbarium of Harvard, has helped us with the literature and exsiccati references. C. O. Erlanson, of the University of Michigan, sent us specimens of willow leaves recently collected in Greenland, upon which we found *Venturia chlorospora* in its asco stage. Written December, 1928.

Injury of this nature has also been very conspicuous in certain sections of New England in the past season. Seen from the distance it is difficult to tell which one is causing the trouble.

Cesati (17) discoverer of the saprophytic stage, Allescher and Tubeuf (7) first describers of the parasitic stage, Karsten (30, 31), Rostrup (47-52) and Aderhold (2--3) were some of the earlier European botanists who made notes on this fungus. Aderhold, of Germany, was the first to definitely associate the two stages as now understood. In an article (2, pp. 80—3) published in 1897 on the scabs of birch, pear, poplar, apple, willow and ash he described both stages of the scabs on these hosts, placing the imperfect stage of each under the form genus Fusicladium and the perfect stage under the genus Venturia. The names applied to the two stages of the willow scab were designated as *Fusicladium ramulosum*, now known as *F. saliciperdum*, and *Venturia chlorospora*.

Recent investigations have been carried on by two European botanists concerning the parasitic nature of this fungus and its action on the willow. Dr. Marie Schwarz (60), of Holland in 1922, published a paper dealing with this and other parasitic fungi found on a species of weeping willow, *Salix alba* var. *vitellina pendula*, in the parks at Utrecht in 1920. Mrs. N. L. Alcock(4,5), of Edinburgh, Scotland, has more recently published two short papers dealing with its action on willow rods, *Salix alba* var. *vitellina*. Like Dr. Schwarz, she found a variety of other fungi associated with the death of the leaves and twigs some of which, besides the scab, were apparently parasitic. However, there has been some doubt even after these investigations as to how important the scab was in such outbreaks. We have attempted in our investigations to clear up some of the doubtful points in its life history and to determine methods of control by spraying.

PART I. AMERICAN INVESTIGATIONS

Distribution

The willow scab in its conidial stage was first definitely recognized in Connecticut, at Norfolk, in late June, 1927. Mrs. Parmelee who wrote to the Experiment Station of injury to her willows had, however, noticed the trouble the year before, but the cause had not been determined. Our visit to Norfolk was made some time after the leaves had been killed (Plate X, a) and many had fallen, so that at first we were not sure of the cause, thinking possibly a late frost, which was said to have occurred, might have been responsible. Identification was made more difficult by the fact that many of the leaves showed no fruiting stage of this fungus while other fungi had become more or less prominent on the dead tissues. The responsible fungus was soon located,

compared and found identical with European specimens of the willow scab. Now that its characteristic appearances are known it is easily recognized by us if present on the dead leaves or twigs.

Soon after its location at Norfolk, information was received from various sources of its presence in restricted localities in eastern New York, western Massachusetts and in near by locations in Connecticut, on both willow trees and shrubs. On a visit during August of 1927, the senior author also found the disease causing great damage to large willow trees at Weymouth and Digby in Nova Scotia (Plate XI, a, c,) and to a less extent at Greenwich in New Brunswick, Canada, and although the auto trip also included all the New England states except Vermont, it was not observed further in any of these.

To date, in Connecticut, the disease has been surely located in sixteen towns in the northwestern part of the state. These towns are Bridgewater, Canaan, Cornwall, Goshen, Kent, Litchfield, Norfolk, North Canaan, Salisbury, Sharon, Southbury, Torrington, Warren, Waterbury, Winchester, Woodbury. However, in three or four other towns removed from that region, occasional dead twigs of certain species of willows have been found that superficially resembled those seen on the willows in the infected district but, as the fruiting stage of the fungus was not found on any of them, we have left their identification as extremely doubtful. It is quite possible that in these cases the injury, resembling fireblight, was caused by bacteria, since they were sometimes found in the dead tissues. Bacterial diseases of this nature have been described elsewhere but as yet we have made no special study of such a trouble in Connecticut.

A camping trip, in late June, 1928, made by the senior author with students at Keene, New Hampshire, disclosed the fungus abundant on some highway trees in the town of Dublin. It has also been reported to us as occurring prominently in the Bridgewater valley in Vermont, although we have received no specimens from that state. In August it was found by the junior author in New York state on the Hudson-Hillsdale highway. Specimens have also been sent to us from the Lebanon mountain region in New York, found on the road from Pittsfield to Albany.

In July of this year a short auto trip from Canaan, Conn., north into the Berkshires through Sheffield, Great Barrington, Southbridge, Lenox and Pittsfield, Massachusetts, revealed the disease as common along the highway on the trees and shrub willows at these places. This is a region where large willows are very common and form a conspicuous part of the landscape. Specimens from this part of Massachusetts have also been sent to us for determination. The disease was seen by Mr. McDonnell of the botanical department in the vicinity of Easthampton and Northampton, but we have no record of its presence further eastward in Massachusetts, though it has been looked for as far east as Boston and from there north to the Maine line.

Early in the summer of 1928, Maine specimens were sent us from Salisbury Cove, on Mt. Desert Island, and from Brooklin, both in Hancock county. Later, in August, the senior author made an auto trip along Route 1 of the National Highway and saw diseased trees common from the state line at Calais all the way south to Bath, but few below the latter city. These infected trees were at or near the following cities: Calais, Pembroke, Dennysville, East Machias, Machias, Whitneyville, Harrington (Plate XII, c), Cherryville, Ellsworth, Salisbury Cove (Plate XII, d), Bar Harbor, Blue Hill, Brooklin, Bucksport, Lincolnville, Camden, Wiscasset, Wells, Kittery Point. The disease was reported by other observers from Belfast, Waldoboro and Goulds-boro.

Previous to the Maine trip the senior author also visited Nova Scotia (including Cape Breton Island), Prince Edward Island and New Brunswick and saw the disease on the susceptible species *Salix alba* var. *vitellina* practically everywhere it occurred over the 1200 miles traveled by auto. This species is a common street and shade tree in this region. The towns, or vicinities near them, where the disease was seen were as follows: In Nova Scotia proper at Yarmouth, Argyle, Shelburne, Liverpool, Bridgewater, Lunenburg, Mahone Bay, Hubbards, Black Point, St. Margarets Bay, Halifax, Waverly, Oakfield, Enfield, Stubenacadia, Stewiacke (Plate XI, b), Brookfield, Truro, New Glasgow, James River, Antigonish, Heatherton, Afton, Monastery; in Cape Breton Island at Margaree Forks, Margaree Harbor (Plate XI, d), Cheticamp, Badeek, Sydney, Big Pond, Big Pond Center, Cleveland; in Prince Edward Island at Charlottetown, North River, New Haven (Plate XII, a); in New Brunswick, at Cape Tormentine, Sackville, Moncton, (Plate XII, b), Salisbury, Sussex, Hampton, St. George, St. Andrews and at various places between those last mentioned. We also understand that the disease has been found in Quebec though we have seen no specimens from there.

Hosts

Fusicladium Stage:

More attention has been paid by us to determine the species of willows attacked in Connecticut than elsewhere, so most of the species reported here are from this state. Those on which we have found the fungus are as follows:

1. *Salix alba*: Conn., Me.
2. *S. alba* var *vitellina*: Conn., Mass., Me., N. H. (this may be *S. alba* x *fragilis* = *S. rubens*, according to Rehder), N. Y., Vt.; N. Scotia proper, C. Breton Isl., P. Edw. Isl., N. Brunsw.
3. *S. cordata*: Conn., Mass.; P. Edw. Isl.
4. *S. discolor*: Conn.

5. *S. lucida*: Conn.
6. *S. nigra*: Conn., Mass., N. Y.
7. *S. pentandra*: Conn., Me.; N. Scotia proper.
8. *S. sericea*: Conn.
9. *Salix* sps. undet.: Conn., Me.; N. Scotia.

Venturia Stage:

From literature we have learned of the North American distribution of the asco stage as follows:

1. *Salix arctica:* Ellesmere Isl. (Rostrup), Greenland (Lind).
2. *S. arctica* var. *Brownei*: Greenland (Lind).
3. *S. glauca*: Greenland (Rostrup).
4. *S. grœnlandica:* Greenland (Rostrup).
5. *S. herbacea:* Greenland (Rostrup).
6. *S. reticulata:* Greenland (Lind).

Besides the above we have recently received specimens of dead willow leaves collected June 1, 1928, at Englishman's Harbor, Disko Island, Greenland, by C. O. Erlanson of the University of Michigan. The leaves were collected for *Rhytisma salicinum* (Pers.) Fr., but also had other minute ascomycetes on them. On one of the leaves of these we found the asco stage of *Venturia chlorospora*, (spores more nearly var. *canescens* as they varied from 5.5-8*u* x 16-21*u*, chiefly 16-18*u*, and the asci from 14.5-16.5*u* x 48-54*u*, bristles on perithecia infrequent, perithecia commonly 90-100*u* in diameter), on this additional following host:

7. *S. chloroclados* x *glauca:* Greenland (Erlanson).

Susceptibility and Resistance

There seems to be at least some difference in the susceptibility of different species of willows to this fungus (Plate IX, a-b, free). There has also been quite a difference in its attack on susceptible individual trees and shrubs of the same kind even when growing close together. This latter difference we explain on the supposition that the disease had previously become well established on the badly infected plants, through overwintering on the branches, but not as yet on the less infected individuals and that the spores are washed or carried over the former much more readily than to adjacent plants. In time, however, if conditions prove favorable, the latter should become badly infected. For example, along the highway from Norfolk to Canaan there are numerous large willows, some apparently of the same variety as those in the village yet the disease gradually decreases outside of Norfolk to become inconspicuous at Canaan several miles distant. Some of these trees, however, may be crosses with *Salix alba* (Plate IX, c). At Calais, Maine, there is a row of *Salix alba* var.

vitellina of about a dozen trees reaching from the water to the highway. Those next the road were badly diseased in August, 1928, while those near the water (Plate IX, d) showed very little injury.

On the other hand *Salix alba* (Plate IX, a, shows catalpa and willow), although reported infected in Europe, seems to be resistant here, since we have rarely found it on that species even where the disease exists nearby on its variety *vitellina* which is the most susceptible of all the willows yet observed.

On two of the estates at Norfolk are several trees determined by us as the Bay-leaf willow, *Salix pentandra*, but although these are very near badly diseased trees no disease was found on them in 1927 and only occasional infected leaves in 1928. This species, however, seems to be one of those infected in Maine, although not as seriously as var. *vitellina*. *Salix nigra* is another large shade tree that has been rather badly injured though the fungus does not seem to fruit so abundantly on it. *Salix cordata* (Plate X, c) is apparently the most susceptible of the native willow shrubs. So far we have not seen the disease on the weeping willow, *Salix babylonica*, although it occurs occasionally in the infected regions and is reported from Europe as a host.

Injury to Trees

The worst injury to large trees, mostly *Salix alba* var. *vitellina*, was seen at Norfolk, Conn. (Plate X, b), Hancock county, Maine, and general in Nova Scotia. In the last region, according to a farmer interviewed, the disease, as in Connecticut, appeared conspicuously in 1926 but much more so in 1927. When first seen by the senior author in August of the latter year (Plate XI, a, c), some of the large trees had no, or very few, leaves on them and could easily be mistaken for dead trees. In 1928 in different parts of Nova Scotia hundreds of dead trees were seen and many more so badly injured that another season's attack was likely to finish them (Plate XI, b, d). The situation in Maine, in Hancock county along the coast (Plate XII, c, d), was not much better.

At Norfolk, by the end of June, 1927, the very large trees of *Salix alba* var. *vitellina*, which are conspicuous shade trees in the village, were partly to largely defoliated although later some new leaves were put out. In 1928, with an unusually wet spring and summer, by the first of August there was not a single untreated tree of this variety (Plate X, b) that was not completely or very nearly completely defoliated and very few if any new leaves were put out. It looks as if many of these trees were doomed, as they have gone through at least three seasons of more or less complete defoliation, and early this season most of the smaller twigs and many of the large branches were dead. Already several fairly young trees have been killed or so severely injured that only the

main trunks are alive. These trees were so weakened by the general attack on the leaves and young twigs very early in the several seasons that starvation and winter injury killed the large branches which were not directly attacked.

Bad as healthy willows are in littering the ground with dead twigs, after passing through last winter, the litter of twigs on the ground under the infected trees was unusually conspicuous, although only a comparatively few had yet broken off. We have seen no fungous disease of trees where the injury has been so sudden and severe as from this fungus, though the chestnut blight and the white pine blister rust in the long run cause more serious financial loss and eventually just as serious injury to the trees.

The fungus carries over the winter on the young twigs infected the previous year. In the spring the Fusicladium stage appears on these and the spores are washed down on the very young leaves in the opening buds, so that their death may occur before they have reached any size, much as occurs with the leaves of the sycamore from the anthracnose fungus. Some young leaves, however, escape infection only to succumb later. If the moist favorable weather continues, nearly full grown, or even full grown, leaves may suddenly rot on the trees and adhere there for some time, presenting a very mournful sight. They then dry up and gradually fall off leaving the trees more or less completely defoliated. Bad defoliation two or three years in succession seems to be fatal since after the first year, little adventitious foliage is put out and gradual starvation results.

If the tissues of the leaves are fairly mature when first infected, the infection may stop after killing spots of varying size in the otherwise healthy green tissues (Plate XIII, b). Often where the large, but still young, leaves are attacked the rot spreads down the midrib to the base killing the tissues as it advances. Quite frequently in these cases it reaches through the petiole into the tissues of the young twigs and causes a more or less conspicuous canker there (Plate XIII, a). If girdling occurs the twig, with its attached leaves above, soon dies. These dead twigs and leaves assume a reddish-brown or blackish color according to the species of willow. The fruiting stage may or may not be found on the dead twigs and leaves, apparently developing much more on some willow species than on others and, of course, not developing on tissues that have been indirectly killed by the action of the fungus.

The Fungus

The spring and summer of 1928 were unusually favorable not only for this scab but for all related scabs. Apple scab obtained an early start and its injury was much greater than in ordinary years; Pear scab, too, was more prominent than usual. Although known in New England for some time, we had not previously

listed the Poplar scab, *Fusicladium radiosum* (Lib.) Lind (*F. ramulosum*, *F. Tremulae*) from Connecticut. This year it has been found common not only in this state but in New Hampshire, Vermont and Massachusetts.

The chief aid in identifying the presence of the willow scab is the characteristic appearance of its fruiting stage. This develops usually on the under side of the leaves but is rather infrequent on the cankered areas of the young twigs. It may appear on these latter next year in early spring and produce the first infection of the leaves. It shows on the leaves as small dense olive-brown pustules which more or less cover the surface, but which particularly follow the downward course of the larger veins and especially the midrib (Plate XV, a).

The spores are olive to reddish-brown in color. They are truncate at the base, generally rounded at the apex, and have one, rarely two, or very rarely three septa. They vary from 12*u* to 25*u* long and from 6*u* to 10*u* wide. When two-celled, the basal cell is usually considerably longer and is somewhat broader (Plate XV, d). They are borne singly at the tips of the conidiophores. Apparently only one spore is formed on each conidiophore.

In cultures there is formed a dense velvety olive-brown growth on which the spores are usually abundantly developed in two to three weeks (Plate XV, b). The spores are somewhat larger than in nature, varying from 9-12*u* x 18-36*u*, and largely disappear through germination in old cultures. With age the mycelium is of similar color to the spores, moderately septate and branched and varies from 2.5*u* to 7.5*u*, chiefly 4-6*u*, in diameter. Not infrequently rounded, larger cells (9-15*u*) occur in the mycelium but are not thickened like chlamydospores. In old cultures imperfect perithecia appear somewhat sparingly. We have not yet been able by crossing with other species of Fusicladium or by stimulation to bring them to maturity. They appear similar to the immature perithecia we have found on sections of leaves, mentioned later.

The conidiophores on the leaves are closly compacted together to form the fruiting pustule. They arise from a more or less extended sclerotial mass of rounded cells (Plate XV, c) from which they are not always very clearly marked off. In general their erect habit, their brownish color, about the same as that of the spores, and their separation from each other above serve to distinguish them. They have one to several septa and at their base they gradually merge into the cells of the sclerotial mass. As a rule they are as long or longer than the spores and slightly narrower. Occasionally sections through the old leaves show more elongated, fewer and laxly clustered conidiophores that have borne spores both at and near their tips. We believe that these are always the conidiophores of the saprophytic Cladosporium.

Although the writers have made attempts to locate the Venturia stage of this fungus as described by Aderhold on the old leaves, have searched the twigs and leaves during the growing season and examined them especially at the time in the spring when infections from this stage would naturally take place, we have as yet failed to find it. Occasionally, however, in the sections made of infected leaves taken from the trees, we have found immature perithecia closely associated with the Fusicladium that may be the asco stage. Apparently, no one has yet made cultures from the Venturia stage and by this means, or by inoculations, proved its relationship to the Fusicladium. We have little doubt that the Venturia fungus eventually will be found here. We do doubt, however, if it is the asco stage, that it is as important in primary infection (unless occurring on the twigs on which it has not yet been reported) as the Fusicladium stage produced in early spring on the twigs from the overwintered cankers. This condition has also been found to be true with certain hosts of the pear and apple scabs in Connecticut and in England.

Associated Fungi

As stated earlier in the paper, certain of the workers with the Fusicladium stage of this fungus have found other fungi associated with it, some of which they have considered parasites and so apparently responsible for part of the trouble in the outbreak. Dr. Schwarz (60), for example, mentions three parasitic fungi, one of which, *Phoma intricans*, is described as new. The second is an ascomycete belonging to the genus Physalospora, determined by her as *P. Salicis* (Fckl.) Rab. She also notes that two other species of Physalospora, *P. gregaria* Sacc. and *P. Miyabeana* Fuk., have been mentioned as parasites of the willow. Lastly she gives *Discella carbonacea* (Fr.) Berk. & Br. as the third parasite.

Mrs. Alcock (5) in her article mentions the following fungi occurring on willow rods as parasites of greater or less intensity: *Physalospora gregaria* Sacc., *Cryptomyces maximus* (Fr.) Rhem, *Scleroderris fuliginosa* (Pers.) Karst. and *Myxosporium scutellatum* (Otth) Petrak.

Very recently Nattrass (42, 43), of England, has published articles on the parasitism of *Physalospora Miyabeana* Fuk., in relation to *Fusicladium saliciperdum*, as a cause of the disease of willows. Contrary to other investigators he is inclined to believe that the willow scab, at least in England, plays a secondary part to the Physalospora. He makes the following statement at the conclusion of his second article (43): "From these preliminary observations and experiments it appears that on the basket willow in Somerset *F. saliciperdum* cannot be regarded other than as a follower of *P. Miyabeana* and that it is in no way responsible for the symptoms of the disease on the leaves."

In our examination of the diseased willow leaves and twigs we have not paid especial attention to the other fungi that occurred on the dead tissues. We have, however, noted species present belonging to the following genera: Coniothyrium, Cladosporium, Alternaria, Fusarium, Cryptostictis, Monochætia, Pestalozzia, Glœosporium and Physalospora.

We have considered only the Glœosporium and the Physalospora, of the other fungi observed by us, as possible parasites. A culture of each from twigs was obtained by the junior author. The latter fungus seems to agree with the Physalospora described by Nattrass. Likewise it approaches *Glomerella cingulata* the common bitter rot fungus that is often a serious parasite on various hosts in the United States, but preliminary inoculations of apples with it (with one exception) and with the Glœosporium from the willows failed to take while those made at the same time with cultures of the bitter rot fungus were all successful. Further study is needed before we can definitely state their identity. We have, as yet, made no inoculations with cultures of these fungi on willows so judge of their parasitism merely from their appearance in nature, especially on twig cankers. However, if we consider the results of our infection experiments with pure cultures of *Fusicladium saliciperdum*, recorded here later, both, if involved, are secondary parasites in causing the willow disease in this country.

It is interesting to note that the three writers mentioned here, as well as ourselves, have all found a species of Physalospora (or by some it might be considered Glomerella) associated with the willow trouble. It is possibly the same fungus in all cases, although each of the writers noted gives a different specific name to it.

Infection Experiments

Apparently in Europe not much has been done dealing with artificial cultures of the willow scab, or inoculating willows with such cultures. Nattrass (42, 43) of England, however, has recently obtained cultures of the fungus but reports failures from his inoculations. The writers, therefore, have made special efforts along these lines. The junior author, in 1927, obtained cultures of the Fusicladium stage of the fungus from material collected at Norfolk. The chief difficulty in isolating these cultures is to avoid the common and saprophytic species of Cladosporium which is frequent on the dead willow leaves.

Infection experiments with these pure cultures were carried on at the Station laboratory at New Haven in the spring of 1928 on cuttings of various willows kept in water in battery jars. These did not prove very effective. While the leaves of the inoculated shoots died sooner, in most cases, and the contrast in the early period with the checks was usually evident and sometimes marked, the fungus did not fruit on the inoculated shoots possibly because of unfavorable conditions not yet determined.

Later, June 4th, leaves mostly immature were inoculated in Petri dishes with spores from these same cultures. The spores were sprayed over the leaves and four days later, while the leaves were still entirely green and showing no signs of injury, they were fixed and later sections made of them. Careful search of these sectioned leaves occasionally revealed germinating spores next the epidermal cells with rarely an indication that a germ tube had pushed in the wall between two adjacent cells. Mycelium similar to that of the Fusicladium was found sparingly in certain sections between the cuticle and epidermal cells and between and under the latter. In no case, however, were we able to actually connect the germinating spores on the outside with mycelium within the tissues. We do not, therefore, assert that these inoculations were successful although the results seem to indicate that they were.

Other experiments, however, carried on at about the same time at the Mt. Carmel farm of this Station, on growing basket willow shoots in an isolated place (Plate XVI, foreground of inset) where the disease is unknown for many miles, proved very conclusively that the scab fungus isolated from the Norfolk willows was responsible for the injury. Seven inoculations (April 13, April 27, May 7, June 4, June 14, June 20 and July 11) were made on these willows, beginning before the leaf buds were open on some of them, just as they were opening on others, on various stages of leaf growth and ending with the fully grown leaves. These inoculations were made usually in the afternoon on cloudy days or just before rains. With an atomizer containing water in which was an abundance of spores from the cultures, the sprouts were sprayed from the top to bottom with a fine mist. Then with a medicine dropper additional material was dropped on the leaves and buds here and there.

The typical disease appeared as the result of all these inoculations, except the last, killing the young leaves and finally the young stems, spotting the more mature leaves, producing cankers at the base of the infected leaves and finally fruiting in normal manner on the leaves and occasionally on the dead shoots. Uninoculated shoots at the further end of the inoculated rows remained free from the disease. There were five different varieties of basket willows in the experiment. These had been received from the U. S. Dept. of Agric., several years before, and were labeled Purple No. 2 (*S. purpurea*), American Green (*S. cordata* ?), American (*S. cordata*), Common Purple (*S. purpurea*) and Lemley (*S. lucida* ?). At the time of the first inoculation on April 13, the condition of the buds on the different varieties was as follows: Purple No. 2, leaf buds out the most of any; American Green, catkins only out; American and Common Purple, leaf buds out a little; Lemley, leaf buds not out at all.

From the tables that follow it appears that the American willow, *Salix cordata* (Plates XIII, b, and XVI) was by far the most sus-

ceptible and the American Green and Lemley moderately susceptible, while the purple varieties were only slightly susceptible. Not all of the inoculations took equally well, those made April 27 and May 7, after the buds were open but before the leaves were fully developed, were the best. With *Salix cordata*, however, the earliest inoculation of April 13 was also very successful since the leaf buds were somewhat open on that date. The last inoculations, made on July 11, apparently were not successful in any case.

TABLE 1.—SHOWING NUMBER OF TWIG INFECTIONS (FIRST FIGURE) AND LEAF INFECTIONS (SECOND FIGURE) ON JUNE 4.

Variety.		Date of Inoculations and Results.		
		April 13	April 27	May 7
Purple No. 2	Row 1	14–?*	?–11	0–1
American Green	Row 2	0–0	2–24	2–13
	Row 3	2–4	4–21	0–6
American	Row 4	5–244	19–130	0–31
	Row 5	4–60	20–73	0–76
Common Purple	Row 6	3–8	4–2	0–3
Lemley	Row 7	3–1	14–21	4–6
	Row 8	0–4	6–8	8–16
	Row 9	0–0	1–2	5–35

*Tip of twigs with very young leaves all killed.

TABLE 2.—SHOWING NUMBER OF INFECTIONS (FIRST FIGURE) ON NUMBER OF INOCULATED WILLOW SPROUTS (SECOND FIGURE) TAKEN ON JUNE 27.*

Variety.		Dates of inoculations and results.							Av. inf. per sprout
		April 13	April 27	May 7	June 4	June 14	June 20‡	July 11*	
Purple No. 2	Row 1	14 on 17	13 on 12	3 on 7	2 on 5	0 on 5	0 on 6	0	.6
American Green	Row 2	3 on 4	59 on 8	29 on 9	27 on 9	9 on 6	0 on 6	0	3.5
	Row 3	18 on 4	58 on 7	54 on 11	21 on 7	6 on 4	0 on 6	0	
American	Row 4	245 on 16	143 on 9	79 on 5	70 on 7	26 on 6	12 on 5	?	10.7
	Row 5	89 on 7	112 on 7	65 on 6	46 on 7	21 on 6	15 on 5	?	
Common Purple	Row 6	13 on 32	11 on 13	4 on 10	1 on 7	3 on 6	1 on 6	0	.5
Lemley	Row 7	36 on 13	42 on 7	13 on 3	36 on 5	2 on 6	9 on 5	0	
	Row 8	6 on 5	18 on 9	28 on 6	18 on 6	11 on 5	7 on 5	0	3.3
	Row 9	4 on 4	2 on 6	44 on 7	66 on 8	7 on 7	17 on 5	0	

* Except counts of inoculations made on July 11 were taken on Sept. 27.
‡ Counts for this inoculation were probably made too soon to get all the infections.

The earlier inoculations were much more favorable for infection than the later ones. Omitting the last inoculation which seems to have been too late for any infection, if we take the results of all of

the first-three inoculations and compare them with all of those of the second-three, we find that the former showed 1205 infections on 244 rods or an average of 4.9 infection per rod as compared with 433 infections on 161 rods or 2.6 infections per rod on the latter. This would indicate that infection in nature takes place much more readily on very young or scarcely mature leaves than on the fully grown leaves which agrees with our observations made at Norfolk.

It was not easy to determine the exact number of infections that resulted from these inoculations; for instance, several infections may have occurred on the same leaf and run together, or the tip of the twig, with its adhering leaves, may have been killed as the result of several rather than one infection. Consequently the number of infections that took place as recorded here is probably under rather than over estimated. There were over 1600 separate infections of which over 100 showed in dead blackened twigs two to six inches in length or in cankers on the young stems at the base of an infected leaf. In Table 1 there is given the number of infections resulting from the first three inoculations, as shown from the examination of June 4. The first figure in the table indicates the number of twig infections that were found, while the second the number of isolated leaf infections. In the second table data are given for all the inoculations from an examination made on June 27, except for the last inoculation which was examined on Sept. 27th.

Spraying Experiments

In order to determine if this disease could be controlled by spraying, treatments were made on four large willows at Norfolk which had been seriously injured the two previous seasons by this fungus. The power sprayer shown in Plate XIV, a, was used and thorough treatments were given by the operator climbing the trees (Plate XIV, b). Five treatments were made on the following dates: April 18, May 4, May 18, May 25, and June 6. Two of the trees did not receive the first treatment which was made with Bordeaux mixture only. This was intended as the dormant treatment before the leaf buds began to open, but as the spring at Norfolk was very slow in developing the second treatment on all four trees was practically a dormant treatment also. The third and fourth treatments were made on the growing leaves when about one-third and two-thirds grown, and the fifth on the leaves just after they had reached full size. Because of the very wet weather after the last treatment if it had been succeeded by another, say the second which took place at the same stage as the first, the treatments would have been better placed and probably more effective. After the first treatment two of the trees were sprayed with home-made 4-4-50 Bordeaux mixture and the other two with commercial dry lime sulphur, three pounds to fifty gallons of water.

Considering that these trees had suffered severely from this disease the two pervious years at least and that about 50% of the young twigs and a number of the large branches were dead before the treatments were started, the results of the spraying were very encouraging. When examined on June 5th, as the disease was just beginning to show serious headway, there were comparatively few dead leaves on them when judged by the two adjacent unsprayed trees whose foliage was badly infected. See Plate XIV, c, d, for one each of the sprayed and unsprayed trees, photographed in August. Seen last late in September, while there were some dead leaves showing infection had taken place, there was considerable healthy foliage on the living twigs and all four sprayed trees had by far the best foliage of any of the trees of this variety in the village, since all the unsprayed trees were very largely or completely defoliated.

There was not much difference between the two trees sprayed with Bordeaux mixture and the two with lime-sulphur. No injury was noticed from any of these treatments. As the Bordeaux stuck much better, we are inclined to favor this fungicide so far. We believe where thorough and timely treatments are given and the trees are not too far gone with the disease, it can be checked and in time satisfactorily controlled by four or five sprayings made each year as follows: 1st, on the dormant trees just before the buds begin to open; 2nd, on the very young leaves emerging from the buds; 3rd, on the young leaves one-third to two-thirds grown; 4th, on the leaves just as they reach full size; 5th, if necessary in wet seasons, a week or ten days after the 4th treatment.

Additional Note.

March 31st, 1929. Since this paper was written (a summary of which was given before the Canadian Mycologists at their meeting in December, 1928) we have received a letter that raised the question whether *Fusicladium saliciperdum* or *Physalospora Miyabeana* was the principal cause of the disease in North America and Europe, citing the work by Nattrass in England, as well as observations made in Canada, as reason for believing that the latter fungus was the responsible agent.

We have, therefore, repeated our indoor infections with pure cultures of *Fusicladium saliciperdum*. We can now state more certainly than we did before that our indoor infections of willow rods in battery jars and of leaves in Petri dishes, previously reported, were due to the *Fusicladium saliciperdum* spores sprayed on them. Apparently this fungus does not fruit, at least readily, under these conditions. However, we secured all the types of infection before noted in this second test. While the fungus has not as yet fruited on the dead tissues, by washing infected pieces in sterile water, corrosive sublimate and again in sterile water, we were always able to recover the fungus in fruiting condition when these tissues

were placed in Petri dishes in nutrient agar and in no case did the fungus Physalospora contaminate the cultures.

We have also tried a few infection experiments with pure cultures of our so-called *Physalospora Miyabeana* and apparently got somewhat similar results with it. However, we need to repeat these inoculation experiments a number of times before we can say just what kind of infection results. We can state very positively, however, that it is not necessary for this fungus to be present to secure serious injury to willows from inoculations with *Fusicladium saliciperdum*, such as is characteristic in nature on their very young leaves in the spring. We are inclined to believe that *Physalospora Miyabeana* is more likely to be responsible for the less serious injury to the mature tissues later in the year, as we have found a disease on the mature leaves, with concentric lines of growth, that we think was caused by it.

In any case we believe Nattrass was wrong when he states that *Fusicladium saliciperdum* "is in no way responsible for the symptoms of the disease on the leaves". Just why Nattrass failed to obtain infection with *Fusicladium saliciperdum* on willow leaves we do not know. We are inclined to believe, however, if he used pure cultures of this fungus, it was either due to failure to inoculate young tissues, or to lack of continued favorable moisture conditions. It is very essential that these conditions prevail and their absence is apparently the chief reason why the disease is not serious in most years.

PART II. EUROPEAN HISTORY

In the preceding part we have dealt with the willow scab as it occurs in America, based chiefly on our own work. In the present part we aim to treat of it briefly in a historical way, dealing with the investigations made in Europe where both the saprophytic and parasitic stages were first discovered. From these investigations there has resulted a somewhat extended bibliography, a duplication of names resulting in a limited synonomy, the issuing of dried specimens in various exsiccati and much of our knowledge relating to the hosts and distribution of the fungus. We shall treat of these separately.

Synonomy

Venturia chlorospora (Ces.) Karst. Fung. Fenn. Exs. No. 957. 1870.

Sphaeria chlorospora Ces. in Rabh. Fung. Eur. No. 48. 30 My. 1859.

Sphaerella chlorospora Ces. et De Not. Comm. Soc. Critt. Ital. **1**[4]: 237. Ja. 1863.

Sphaerella ditricha Awd. *p. p.* in Rab. Fung. Eur. No. 943 1866.

(1) ? *Sphaerella canescens* Karst. Fung. Fenn. Exs. No. 895. 1869.

Venturia chlorospora (Ces.) Karst. Fung. Fenn. Exs. No. 957. 1870.

Venturia chlorospora Karst. *p. p.* Myc. Fenn. **2:** 189. 1873.

(1) ?*Venturia chlorospora* var. *canescens* Karst. Myc. Fenn. **2:** 190. 1873.

Venturia chlorospora Wint. *in litt.* in de Thüm. Myc. Uni. No. 560. 1876.

Fusicladium ramulosum Rostr. *p. p.* in Müll. Tidsskr. Skovs. **6:** 294. 1883.

Venturia chlorospora Wint. *p. p.* Rab. Krypt. Fl. **1**[2]**:** 436. 1887.

Septoglœum saliciperdum All. & Tub. in All. et Schn. Fung. Bav. No. 485. 1895.

Venturia chlorospora Aderh. in Hedw. **36:** 82. Ap. 1897.

Fusicladium saliciperdum Tub. in Arb. Biol. Abt. Land-Forstw. Kaiserl. Gesundh. **2:** 567-70. 1902.

Fusicladium saliciperdum Lind in Ann. Myc. **3:** 430. 1905.

The preceding names indicate the synonomy as we have found it in the literature. We have had to depend for this information partly on the opinion of others as we have not critically examined the specimens listed in the exsiccati, though we have seen all of them and almost all of the references to literature reported here. Those we have failed to see are indicated by a star (*) before the name.

It appears from our investigations that Cesati was the first to describe this fungus, under the name *Sphaeria chlorospora*, in 1859 from specimens of the asco stage on species of willow (*Salix triandra, S. alba*) collected at Vercelli, Italy. A few years later in 1863, he and De Notaris changed the name to *Sphaerella chlorospora*. In 1866 Auserwald used the name *Sphaerella ditricha* to include this species as well as others now considered distinct on Betula, Salix, Sorbus and Fraxinus.

In 1869 Karsten described *Sphaerella canescens* from Finland and later, in 1873, named it as a variety of *Venturia chlorospora*, namely var. *canescens*, distinguishing it by very slight differences in the spores. Aderhold (2, p. 82), however, gives it as a synonym of *Venturia chlorospora*. We include it here not because we doubt its varietal difference but because we believe that all of the specimens collected on Salix need to be gone over thoroughly to determine what if any varietal or specific differences there are. Karsten, also, was the first to place the fungus under the

(1) Said to have differently tinted and narrower spores.

proper genus, Venturia, as he issued specimens on willow (Fung. Fenn. Exs. No. 957) in 1870 as *Venturia chlorospora*. Therefore he is quoted by us as the second authority for the specific name. Karsten, however, in 1873 used the name *Venturia chlorospora* not only for this fungus but also included with it the species on poplar which is now considered distinct.

Winter, likewise, as early as 1876 issued specimens of the asco stage, in de Thümen's exsiccati on Salix sps. under the name *Venturia chlorospora* with Wint. *in litt.* as the authority. In 1887 he (72) showed that he also included other hosts with it.

Ordinarily the mature stage is cited as *Venturia chlorospora* (Ces.) Aderh. This is because Aderhold (2) in 1897, brought together the two stages on the willow for the first time under this name and limited the species to Salix as a host. So much for the asco stage.

The parasitic stage was first called *Septoglœum saliciperdum* in 1895 by Allescher and Tubeuf (7) but in 1902 the latter (70) renamed it *Fusicladium saliciperdum*, three years before this name was applied to it by Lind. This would make the proper combination for this stage *Fusicladium saliciperdum* (All. & Tub.) Tub. Tubeuf in his article states that Dr. Merck first called his attention to the willow disease in 1884. Rostrup (47), apparently the first to recognize the disease in 1883, used an older name, applied only to the scab of poplar *Cladosporium ramulosum* by Desmazier (or by Roberge according to Rostrup and Tubeuf), to include both these species under the name *Fusicladium ramulosum*. Aderhold (2) used the name *Fusicladium ramulosum* Rostr. for the conidial stage of the willow scab only but recognized that the fungi on the willow and poplar were distinct, calling that on the poplar *Fusicladium Tremulae* Fr.

Exsiccati

Both stages have been issued in various exsiccati. Such as we have been able to find are given in the following lists.

Venturia Stage:

Sphaeria chlorospora Ces. Mspt. et herb. Rabh. Fung. Eur. No. 48. 30 My. 1859.

Sphaeria chlorospora Ces. Erb. Critt. Ital. No. 296. D. 1859.

?*Sphaerella canescens* Karst. Fung. Fenn. Exs. No. 895. 1869.

Venturia chlorospora (Ces.) Karst. Fung. Fenn. Exs. No. 957. 1870.

Venturia chlorospora Wint. *in litt.* de Thüm. Myc.Uni. No. 560. 1876.

?*Venturia chlorospora* (Ces.) Karst. f. *canescens* Karst. Rehm Asc. No. 840. (1884, date of coll.).

Venturia chlorospora (Ces.) Karst. Roum. Fung. Sel. Exs. No. 5838. (My. 1891, date of coll.).

Venturia chlorospora (Ces.) Aderhold. Krieger Fung. Sax. No. 1428. 1899.

Venturia chlorospora (Ces.) Karst. Sacc. Myc. Ital. No. 486. 1900.

Venturia chlorospora (Ces.) Aderhold. Rehm Asco. No. 1340. 1900.

Venturia chlorospora (Ces.) Aderh. Jaap Fung. Sel. Exs. No. 425. S. 1910.

?*Venturia chlorospora* (Ces.) Karst. var. *canescens* Karst. Tranz. et Ser. Myc. Ross. Exs. No. 122. 1911.

Venturia chlorospora (Ces.) Karst. Petrak Fl. Boh. et Mor. Ex., II, 1, No. 782. O. 1913.

Venturia chlorospora (Ces.) Aderh. Syd. Myc. Germ. No. 1565. (5 Jl. 1919, date of coll).

Fusicladium Stage:

Septoglœum saliciperdum All. & Tub. All. et Schn. Fung. Bav. No. 485. 1895.

Fusicladium saliciperdum (All. et Tub.) Lind. Krieger Fung. Sax. No. 2090. 1909.

Fusicladium saliciperdum (All. et Tub.) Lind. Kabát et Bŭbák Fung. Imp. Exs. No. 642. 10 D. 1910.

Fusicladium saliciperdum (All. et Tub.) Lind. Tranz. et Ser. Myc. Ross. Exs. No. 146. 1911.

Fusicladium saliciperdum (All. et Tub.) Ld. Petrak Fl. Boh. et Mor. Exs. II, No. 925. 1914.

Hosts and Distribution

Some of the names of the willows included here are probably synonyms. Because of the geographical changes in Europe in recent years, it is sometimes difficult to determine the distribution of the fungus in the countries as they exist today. According to the information gained we find that the Venturia and Fusicladium stages, with the authority for the same, have been reported as follows:

Venturia Stage:

Salix alba: Italy (Cesati); Europe (Rostrup).

S. [*alba* var.] *vitellina*: Italy (Saccardo).

S. aurita: Finland (Karsten); Germany (Aderhold).

S. Caprea: Denmark (Lind); Finland (Karsten); France (F. Fautrey); Germany (Aderhold, Henkel, Krieger, Schroeder); Moravia (Petrak).

S. cinerea: Germany (Aderhold, Schroeder); Saxony (G. Winter).
S. cuspidata: Europe (Rostrup).
S. fragilis: Europe (Rostrup).
S. glauca: Iceland (Rostrup).
S. herbacea: Iceland (Rostrup); Spitzbergen and Bear Isl. (Lind).
S. herbacea x *polaris*: Spitzbergen and Bear Isl. (Lind).
S. lanata: Iceland (Rostrup).
S. mollissima: Europe (Rostrup).
S. polaris: Spitzbergen and Bear Isl. (Lind).
S. reticulata: Spitzbergen and Bear Isl. (Lind).
S. triandra: Italy (Cesati).
S. viminea: Ungarn (Rehm).
Salix sp.: Brandenburg (H. Sydow); Finland (Karsten); Italy (Saccardo); Waldschlucht (Rehm).

Fusicladium Stage:

Salix alba: Bohemia (Kabát et Bŭbák); Denmark (Lind); Germany (Tubeuf, Lindau); Kursk, Russia (Potebnia).
S. alba var. *vitellina:* Scotland (Alcock).
S. alba var. *vitellina pendula:* Holland (Schwarz.). Bad.
S. americana: Germany (Janson, Appen); Silesia (Pape). Very susceptible. [Possibly our *S. cordata.*]
S. amygdalina: Saxony (Krieger).
S. aurita: Europe (Lind); Germany (Aderhold, Lindau).
S. babylonica: Germany (Tubeuf, Janson).
S. Caprea: Europe (Lind); Germany (Aderhold, Lindau).
S. cinerea: Europe (Lind); Germany (Aderhold, Lindau).
S. cuspidata: Europe (Lind); Germany (Tubeuf, Lindau).
S. fragilis: Europe (Lind); Germany (Tubeuf, Lindau).
S. fragilis x *pentandra:* Denmark (Lind).
S. japonica pendula: Denmark (Lind).
S; laurina: Bavaria (Allescher & Tubeuf).
S. mollissima: Denmark (Lind); Germany (Lindau).
S. nigricans: Germany (Tubeuf).
S. pentandra: Germany (Tubeuf).
S. purpurea: Germany (Appen, Janson). Not very susceptible.
S. viminalis: Germany (Appen, Janson). Not very susceptible.
Salix sps.: Bavaria (Tubeuf); Bohemia (Petrak); England (Nattrass).

Bibliography

No doubt there are other references to this fungus than those recorded here, but these include all we have been able to locate in the time and facilities at our disposal. Those we have not been able to verify in the original we have indicated by a star (*) before the author's name. Exsiccati references are not usually given.

1. **Aderhold, R.** Litterarische Berichtigung zu dem Aufsatze über die Perithecienform von *Fusicladium dendriticum* Wall. Ber. Bot. Ges. **13**: 54-55. 1895.
   Calls attention to investigations previous to his by Goethe-Geisenheim and Brefeld suggesting connection of Fusicladium on apple and pear to *Venturia chlorospora* in its broad conception.
2. **Aderhold, R.** Revision der Species *Venturia chlorospora, inæqualis* und *ditricha* autorum. Hedw. **36**: 67-83. Ap. 1897.
   Describes and figures both spore stages of six species of which the one on willows is called *Venturia chlorospora* (Ces.) Ad. and its conidial stage *Fusicladium ramulosum* Rostr. Lists hosts as: "Conidienform in Frühjahr auf lebenden, Perithecienform in Frühjahr auf todten Blättern von *Salix Caprea, aurita, cinerea* und anderen."
3. **Aderhold, R.** Die Fusicladien unserer Obstbäume, II. Teil I. Landw. Jahrb. **29**: 541-87. 1900.
   On page 550 says the name *Venturia chlorospora* must be used for the Venturia on Salix sps.
4. **Alcock, N. L.** A Dieback, and Bark Disease of Willows, attacking the young Twigs. Trans. Roy. Scott. Arb. Soc. **38**: 128-30. 1924.
   Gives short historical account of *Venturia chlorospora;* asco stage not found so far in Great Britain. Describes effect on host (*Salix alba* var. *vitellina*) of *Fusicladium saliciperdum* and gives spore measurements.
5. **Alcock, N. L.** Successional Disease in Plants as shown in Willow Rods. Trans. Brit. Myc. Soc. **11**: 161–7. Au. 1926.
   Describes willow scab, *Fusicladium saliciperdum*, in its effect on willow rods, *Salix alba* var. *vitellina*, as found in Scotland and mentions *Physalospora gregaria, Cryptomyces maximus, Scleroderris fuliginosa* and *Myxosporium scutellatum* as associated fungi on diseased willow shoots. Gives literature.
6. **Allescher, A.** *Septoglœum salicinum* (Peck) Sacc. Rab. Krypt. Fl. 1^7 : 626-7. 1903.
   States above fungus is distinct from *Septoglœum saliciperdum* All. and Tub.
7. **Allescher, A. et Tubeuf, C.** *Septoglœum saliciperdum* All. et Tub. All. et Schn. Fung. Bav. No. 485. 1895.
   Described as a new species in this exsiccati apparently before it was in the next reference.
8. **Allescher, A. et. Tubeuf, C.** *Septoglœum saliciperdum* Allescher et Tubeuf. Ber. Bayer. Bot. Ges. **4**: 38. 1896.
   Describe this species on *Salix laurina* from Bavaria; note that it was issued under this name in All. et Schn. Fung. Bav. No. 485.
9. **Anon.** Review. Rev. Appl. Myc. **2**: 92-4. Fe. 1923.
   Reviews Dr. Marie B. Schwarz article (*q. v.* 60) on Dying Twigs of Elms, Weeping Willows and Peach Trees.
10. **Anon.** Review. Rev. Appl. Myc. **4**: 199. Ap. 1925.
    Reviews Mrs. N. L. Alcock's article (*q. v.* 4), Trans. Roy. Scott. Arb. Soc. **38**: 128-30.

11. **Anon.** Review. Rev. Appl. Myc. **4**: 644. N. 1925.
Reviews articles by Pape (*q. v.* 44) who reported *Fusicladium saliciperdum* on willow rods, *Salix americana*, from Silesia where it was extremely destructive and gave directions for control. Pape thinks further investigation is needed to prove *Venturia chlorospora* the mature stage.

12. **Anon.** Review. Rev. Appl. Myc. **6**: 520. S. 1927.
Reviews article by Appen (*q. v.* 15) who stated that in the wet seasons of 1925 and especially 1926, *Fusicladium saliciperdum* devastated willow plantations in Germany, especially those of *Salix americana*, while *S. viminalis* and *S. purpurea* were affected to a slighter extent.

13. **Anon.** Review. Rev. Appl. Myc. **7**: 127. F. 1928.
Reviews article by Janson (*q. v.* 28) on *Fusicladium saliciperdum* which was bad in neighborhood of Berlin on soil deficient in potash. *Salix americana* was especially susceptible while crosses of *S. viminalis* with *S. purpurea, S. daphnoides, S. triandra* appeared to be immune; gives method of control by *nosprasen*.

14. **Anon.** Review. Rev. Appl. Myc. **7**: 129. Mr. 1928.
Reviews article by unannounced author (*q. v.* 78) which states there were complaints from all parts of Germany concerning a die-back of American willows, *Salix americana*, largely due to *Fusicladium saliciperdum;* carried on cuttings; gives means for control; says *S. purpurea, S. triandra, S. viminalis* appear to be immune.

15. **Appen, A. V.** Weidenschorf (*Fusicladium saliciperdum*). Ill. Landw. Zeit. **47**: 67-8. 4 F. 1927.
Notes very serious injury to basket willow (*Salix americana*) in the flood season of 1926 and less so in 1925; describes character of injury; *S. viminalis* and *S. purpurea* were also somewhat infected; worst in soil rich in nitrogen; gives suggestions for control. Gives references to articles on this disease by Dr. Max Wolff (No. 77), and Drs. S. Ludwigs and M. Schmidt (No. 75). See review by Anon. No. 12.

16. **Auerswald, B.** *Sphaerella ditricha* Awd. Rab. Fung. Eur. No. 943. 1866.
Issues it as "*Sphaerella ditricha* Awd. *in litt. et Mspt.*"; gives synonomy and notes differences on different hosts among which are Betula, Salix, Sorbus and Fraxinus. He makes the species to include more than is recognized today and the specimen issued with the note being on Fraxinus excludes it from the exsiccati of *Venturia chlorospora* as understood by us.

17. **Cesati, V.** *Sphaeria chlorospora* Ces. Mspt. et herb. Rab. Fung. Eur. **1**, No. 48. My. 1859.
Describes and figures the asco stage on leaves of *Salix triandra* and *S. alba* from Vercelli, Italy.

18. **Cesati, V.** *Sphaeria chlorospora* Ces. Erb. Critt. Ital. No. 296. D. 1859.
Issued specimens of the above; said to be on *Salix alba* and *S. triandra* from Vercelli, Italy.

19. **Cesati, V. et De Notaris, G.** Schema di classificazione degli Sferiacei Italici Aschigeri. Comm. Soc. Critt. Ital. **1**[4]: 237. Ja. 1863.
Place *Sphaeria chlorospora* Ces. under the genus Sphaerella.

20. **Clinton, G. P.** A New Disease of Willows appears in Connecticut. U. S. Pl. Dis. Rep. **11**: 87. Au. 1927.
Reports trouble caused by *Fusicladium saliciperdum* and the editor adds note. This is the first report of the disease in North America.

21. **Clinton, G. P.** Willow Scab (*Fusicladium saliciperdum*). U. S. Pl. Dis. Rep. **12**: 82. 15 Au. 1928.
Reports above from Conn., N. Y., Mass., N. H. and Me.; found on six species of willows in nine towns in northwestern Conn.; defoliated all trees of *S. alba* var. *vitellina* at Norfolk, Conn., except the sprayed.

22. **Clinton, G. P. and McCormick, F. A.** *Fusicladium saliciperdum* (Leaf Rot) on Willow. U. S. Pl. Dis. Rep. **12**: 54-5. 15 Jl. 1928.
Report this new American disease on willows from Conn., Mass., N. H., N. Y. in the United States and from Nova Scotia and New Brunswick in Canada; list hosts as *Salix nigra, S. alba* var. *vitellina, S. cordata* and possibly *S. sericea*; obtained culture of fungus and proved by inoculation experiments its parasitic nature; got results from four treatments with Bordeaux mixture and lime-sulphur.

23. **Dearness, J.** The Fungi of the Arctic Coast of America West of the 100th Meridian. Rept. Can. Arc. Exp. 1913-18, **4C**: 12C. Je. 1923.
Lists *Venturia chlorospora* as reported on *Salix arctica* from Ellesmere Island.

24. **De Notaris, G.** 97. *Sphaerella chlorospora.* Sfer. Ital. **1²**: 86-7, Tav. 97. 1863.
Gives synonomy, describes and figures fungus under above name. No setae shown on perithecia.

25. **Ellis, J. B. and Everhart, B. M.** *Venturia chlorospora* (Ces.). N. A. Pyrenomycetes: 138. 1892.
Give synonyms, exsiccati, scientific description of above and list on *Salix herbacea* and *S. glauca* from Greenland.

26. **Farlow, W. G. and Seymour, A. B.** *Venturia chlorospora* (Ces.) Karst. Host Index Fungi U. S.: 131-2. 1888.
List on *Salix glauca* and *S. herbacea.* (The revised Index will give hosts as *Salix arctica, S. arctica* var. *Brownei, S. glauca, S. grœnlandica, S. herbacea* and *S. reticulata*).

27. **Henkel, A.** Neues und Bemerkenswertes der Pilzflora Thüringens. Ann. Myc. **21**: 146. 28 F. 1923.
Lists *Venturia chlorospora* on old leaves of *Salix Caprea* from Thüringia, Germany.

28. **Janson, A.** Ueber den Schorf und andere Korbweidenschädlinge. Nachr. ü. Schädl. **2, 3**: 161-4. Au. 1927.
Notes injury to basket willows in Germany, especially on ground poor in potash,by *Fusicladium saliciperdum* during warm wet weather of 1927; describes character of injury to the growing rods and contrasts with frost and hail injury; reports injury in past on *Salix bab(i)lonica* and other ornamental willows but especially bad now on American willow used for basket work while crosses of *S. viminalis* with purple Caspian and almond willows were less susceptible; thinks cutting rods in April rather than in winter may lessen the disease; gives methods of control by clean culture, spraying, etc. Also see review by Anon. no. 13.

29. **Karsten, P. A.** *Sphaerella canescens* Karst. Karst. Fung. Fenn. Exs. No. 895. 1869.
Gives description of above and lists on *Salix acutifolia.*

30. **Karsten, P. A.** *Venturia chlorospora* (Ces.).Fung. Fenn. Exs. No. 957. 1870.
Issues above on Salix from Finland.

31. **Karsten, P. A.** *Venturia chlorospora* (Ces.) Karst. Myc. Fenn. **2**: 189. 1873.
Describes above, gives synonyms and lists on *Salix Caprea, S. aurita* and *Pyrus malus;* describes as variety *canescens* (*Sphaerella canescens* Karst.) on *Salix acutifolia* which differs in slight spore characters (p. 190).

32. **Lind, J.** Über einige neue und bekannte Pilze. Ann. Myc. **3**: 427-32. 10 D. 1905.
Distinguishes (pp. 429-31) between the two species of Fusicladium on Salix and Populus, giving their correct names as *Fusicladium saliciperdum* (All. & Tub.) Lind and *F. radiosum* (Lib.) Lind (*F. Tremulae*), with the proper names for their asco stages as *Venturia chlorospora* (Ces.) Ad. and *V. Tremulae* Aderh. and lists *F. saliciperdum* on *Salix alba, S. aurita, S. Caprea, S. cinerea, S. cuspidata, S. fragilis* and *S. mollissima.* Does not separate Napicladium from Fusicladium as a distinct genus.

33. **Lind, J.** Systematic List of Fungi (Micromycetes) from North-East Greenland. Danmark-Eksped. til Groenl. Nord. 1906-08, **3**: 153. 1910.
Lists *Venturia chlorospora* (Ces.) Karst. on *Salix arctica* from Greenland. This is a separate from Medd. om Grønl. XLIII.

34. **Lind, J.** Fungi (Micromycetes) collected in Arctic North America. Reprint from Vid. Selsk. Skrifter, I Math.-Nat. Klasse **1909**^{9}: 7, 17. 1910.
Lists above fungus on *Salix arctica* var. *Brownei* and *S. reticulata* from Greenland.

35. **Lind, J.** 922. *Venturia chlorospora* (Ces.) Karsten. Danish Fungi in Herb. E. Rostrup: 212. 3071. *Fusicladium saliciperdum* (All. & Tub.). *Ibid.*: 520. 1913.
Lists *V. chlorospora* on *Salix Caprea* and *F. saliciperdum* on *Salix alba, S. fragilis* x *pentandra, S. japonica pendula, S. mollissima* and gives references to collectors and literature.

36. **Lind, J.** The Micromycetes of Svalbard. Det. Kongl. Dep. f. Hand. Sjøf. Ind. Händv. og Fisk. 1928: 21. 1928.
Lists *Venturia chlorospora* on *Salix herbacea, S. herbacea* x *polaris, S. polaris, S. reticulata* from Spitzbergen and Bear Island.

37. **Lindau, G.** Venturia Ces. et de Not. Engler u. Prantl Nat. Pflanz. 1^{1}: 431. 1897. Septoglœum Sacc. *Ibid.* 1^{1}** 407-8. 1900.
Describes genus Venturia and includes several species under *Venturia chlorospora* (Ces.) Karst.; describes genus Septoglœum and states that *Septoglœum saliciperdum* Allesch. et Tub. causes serious injury to *Salix laurina* in South Bavaria.

38. **Lindau, G.** *Fusicladium saliciperdum* (All. et Tub.). Rab. Krypt. Fl. 1^{8}: 776. 16 My. 1907.
Describes, gives synonomy and lists above on *Salix alba, S. aurita, S. Caprea, S. cinerea, S. cuspidata, S. fragilis, S. mollissima,* in Denmark on the authority of Rostrup. Gives *Venturia chlorospora* as asco stage. States Rostrup wrongly included both the species on Salix and Populus under *F. ramulosum,* the proper name for the latter.

39. **Lindau, G.** *F. saliciperdum* (All. et Tub.) Lind (*Septoglœum saliciperdum* All. et Tub.). Sorauer Handb. Pflanzenkr. **2**: 444. 1908.
Lists above on Salix sps. as conidial stage of *Venturia chlorospora.*

40. **Martin, G. H.** *Fusicladium saliciperdum* (All. & Tub.) Lind. U. S. Pl. Dis. Rep. Suppl. 42: 341. 15 S. 1925.
Merely gives reference to Alcock's paper no. 4.

41. **Müller, P. E.** Bot. Centralb. **15:** 151-2. 1883.
Reviews briefly Rostrup's article (*q. v.* 47) on *Fusicladium ramulo* [*r*] *um* which occurs as a parasite on species of willow and poplar, giving description of injury and character of fungus.

42. **Nattrass, R. M.** Economic Mycology. Ann. Rep. Agr. Hort. Res. Sta. Uni. Bristol **1927:** 209, 211, 212. 1927?
Notes presence of *Fusicladium saliciperdum* on willow at Long Ashton; cultures were obtained. Worked with this fungus and *Physalospora Miyabeana* in relation to willow disease.

43. **Nattrass, R. M.** The Physalospora Disease of the Basket Willow. Trans. Brit. Myc. Soc. **13:** 286-306. 26 O. 1928.
Describes *P. Miyabeana* and its attack on *Salix alba* vars. *vitellina* and *cardinalis* and *S. americana*; gives culture characteristics and successful inoculation experiments; compares with *Physalospora gregaria Sacc.* and *P. Salicis* Fuckel and notes relationship to *Glomerella cingulata* (Stonem.) Spauld. & v. Schr.; credits it rather than *Fusicladium saliciperdum* as primarily responsible for the disease of basket willows in England.

44. **Pape, H.** Der Pilz *Fusicladium saliciperdum* (All. et Tub.) Lind als Korbweidenschädling. Deutsche Obst- und Gemüsebau-Zeitung **71:** 326-29. 12 Je. 1925.
Gives a short historical account and comprehensive description of the macroscopic appearance of diseased specimens sent him in February, 1925, from Brieg in Schlesien, where much injury had been caused to basket willows, especially *Salix americana*; notes appearance of disease similar to frost injury for which it may be mistaken; disease worst in very wet years and in situations with abundant nitrogenous matter in the soil; indicates control by clean culture, spraying and cutting rods in late spring rather than in winter or fall; holds above fungus fully responsible for the disease but questions whether connection with Venturia stage has been fully proven as yet. See also review by Anon. No. 11.

45. **Petrak, F.** Beiträge zur Pilzflora von Sternberg in Mähren. Ann. Myc. **25:** 344–88. 1927.
Lists *Fusicladium saliciperdum* (All. et Tub.) Lind, page 384, on living leaves and tips of twigs of Salix sp. on the banks of streams in low ground.

46. **Potebnia, A.** Beiträge zur Micromycetenflora Mittel-Russlands. Ann. Myc. **8:** 42–93. 1910.
States on page 90 that *Fusicladium saliciperdum* (All. et Tub.) Lind on *Salix alba* at Kursk, Russia, badly injured the leaves in June, 1909.

47. **Rostrup, E.** *Fusicladium ramulosum.* Fortsatte, Undersøgelser over Snyltesvampes Angreb paa Skovtræerne. [Separate from Müller's Tidsskr. f. Skovbrug **6:** 199-300. 1883.]
Treats on pages 294-6 of above fungus which he recognizes as a parasite; pictures spores and gives measurements; gives reference to *Cladosporium ramulosum* on *Populus alba* and credits Roberge rather than Desmazier as the authority as given by Saccardo and others, but uses *Fusicladium ramulosum* as proper name and includes as hosts *Populus alba, P. canescens, P. tremula, Salix alba, S. fragilis* and *S. cuspidata*, thus not distinguishing the two species as now recognized. See also review by Müller, No. 41.

48. **Rostrup, E.** Fungi Grœnlandiae. Separate from Medd. om Grønl. **3**: 556. 1888.
Lists *Venturia chlorospora* (Ces.) Karst. on *Salix herbacea* and *S. glauca* from Greenland.

49. **Rostrup, E.** Ost-Grønlands Svampe. Separate from Medd. om Grønl. **18**: 22. 1894.
Lists *Venturia chlorospora* (Ces.) Karst. on *Salix grœnlandica* from East Greenland.

50. **Rostrup, E.** Pileskurv. *Venturia chlorospora* (Ces.) Aderh. Rostrup's Plantepatologi: 464. 1902.
Has note on above and lists on *Salix alba, S. fragilis, S. cuspidata* and *S. mollissima.*

51. **Rostrup, E.** Islands Svampe. Separate from Bot. Tidsskr. **25**: 303. 1903.
Lists *Salix herbacea, S. lanata, S. glauca,* from Iceland, as hosts of *Venturia chlorospora.*

52. **Rostrup, E.** Fungi collected by H. G. Simmons on the 2d Norwegian Polar Expedition, 1898-1902. Rept. Sec. Nor. Arct. Exp. Fram, 1898-1902, No. 9: 7. 1906.
Lists *Venturia chlorospora* on *Salix arctica* from E. Bedford, Pim Island, Hayes Sound.

53. **Saccardo, P. A.** *Venturia chlorospora* (Ces.) Karst. Fungi Ital. No. 349. S. 1878.
Pictures perithecia, asci and ascospores on *Salix vitellina* from Italy.

54. **Saccardo, P. A.** *Venturia chlorospora* (Ces.) Karst. Sacc. Syll. Fung. **1**: 586-7. *Venturia inaequalis* (Cooke) Wint. *Ibid.*: 587-8. 1882.
Describes *Venturia chlorospora* and lists the hosts as Quercus, Salix, Pyrus, Prunus, Sorbus and Crataegus, but follows with short description of vars. of which var. *Salicis vitellinæ* is one. Describes as distinct *Venturia inæqualis* (Cooke) Wint. and lists as hosts *Pyrus Aria, P. communis, P. Malus* but not Crataegus, Salix, Fraxinus, etc.

55. **Saccardo, P. A.** *Venturia chlorospora* (Ces.) Karst. var. *canescens* Karst. Sacc. Syll. Fung. **9**: 687-8. 1891. *Venturia macrospora* Rostr. *Ibid.* **11**: 306. 1895.
States variety differs from *V. chlorospora* by differently tinted and narrower spores; reported on *Salix acutifolia* from Finland. Describes *V. macrospora* on *S. grœnlandica* from Greenland. It has much wider and longer asci and ascospores than *V. chlorospora.*

56. **Saccardo, P. A. et Sydow, P.** *Septogœlum saliciperdum* Allesch. et Tubeuf. Sacc. Syll. Fung. **14**: 1031. 1899.
Describes and lists host as *Salix laurina* from Bavaria.

57. **Saccardo, P. A. et Traverso, J. B.** *Venturia chlorospora* (Ces.) Karst. Sacc. Syll. Fung. **20**: 1123. 1911.
Give reference to illustrations of above fungus.

58. **Saccardo, P. A. et Trotter, A.** *Fusicladium saliciperda* (All. et Tub.) J. Lind. Sacc. Syll. Fung. **22**: 1376. 1913.
Give *Venturia chlorospora* (Ces.) Karst. as asco stage of above and *Septoglœum saliciperdum* as synonym. Notice spelling of *saliciperdum.*

59. Schroeter, J. *Venturia chlorospora* (Cesati). Krypt. Fl. Schl. **3²:** 351-2. 1894.
Describes genus and species. In the latter includes as hosts Crataegus, Apple and Pear (now considered as distinct from that on Salix) with *Salix Caprea* and *S. cinerea*, from Germany.

60. Schwarz, Marie Beatrice. Das Zweigsterben der Ulmen, Trauerweiden und Pfirsichbäume. Med. Phytopath. Lab. Willie Commelin Scholten, Baarn, V: 1-73. D. 1922.
Discusses on pages 33-49 "Das Triebsterben und der Rindenbrand der Trauerweide" caused by *Fusicladium saliciperdum* (All. et Tub.) Tub. on *Salix alba* var. *vitellina pendula* in Holland. Describes in detail effect on host and names saprophytes and parasites that follow on the weakened willows. Failed to get cultures and made no inoculations and not sure about the so-called asco stage.

61. Stevens, F. L. *Fusicladium saliciperdum* (All. & Tub.) Lind. The Fungi which cause Plant Dis.: 606. 1913.
Lists above as stage of *Venturia chlorospora* on Salix.

62. Stevenson, J. A. Foreign Plant Diseases. U. S. Dept. Agr.: 163. 1926.
Under Salix gives *Fusicladium saliciperdum* as a disease attacking *S. alba, S. aurita, S. Caprea, S. cinerea, S. cuspidata, S. fragilis, S. mollissima, S. nigricans, S. pentandra*; reported from Scotland, Russia, Denmark, Holland and Germany with *Venturia chlorospora* as perfect stage.

63. Sydow, P. *Venturia chlorospora* (Ces.) Karst. Sacc. Syll. Fung. **13:** 1078-1102. 1898. *Venturia chlorospora* (Ces.) Karst. var. *canescens* Karst. *Ibid.* *Venturia inæqualis* (Cke.) Wint. *Ibid.* *Venturia macrospora* Rostr. *Ibid.* *Septoglœum saliciperdum* Allesch. et Tub. *Ibid.*
Gives following willows as hosts of *Venturia chlorospora*, Salix sp., *S. Caprea, S. cinerea, S. glauca, S. herbacea*; for var. *canescens* gives *S. acutifolia*; for *Venturia inæqualis* gives Salix sp.; for *V. macrospora* gives *S. grœnlandica;* for *Septoglœum saliciperdum* gives *S. laurina.*

64. Sydow, P. Pilze. Just's Bot. Jahr. **37, I:** 159. 1912.
Notes Krieger, Fung. Sax. No. 2090, issued specimens of *Fusicladium saliciperdum* in 1909.

65. Sydow, P. Pilze. Just's Bot. Jahr. **38, I:** 147. 1913.
Notes Jaap issued *Venturia chlorospora*, No. 425 in Fung. Sel. Exs. in 1910.

66. Sydow, P. Pilze. Just's Bot. Jahr. **38, I:** 148. 1913.
Notes that *Fusicladium saliciperdum* was issued as No. 642 of Kabát et Bubák's Fung. Imp. Exs. in 1910.

67. Sydow, P. Pilze. Just's Bot. Jahr. **39, I:** 206. 1913.
Notes Tranzschel and Serebrianikow issued *Venturia chlorospora* (Ces.) Karst. var. *canescens* Karst, No. 122, and *Fusicladium saliciperdum* (All. et Tub.) Lind, No. 146, in Myc. Ross. Exs. in 1911.

68. Sydow, P. Pilze. Just's Bot. Jahr. **41, I:** 200. 1919.
Notes Petrak issued specimens of *Venturia chlorospora*, Fl. Boh. et Mor. Exs. II, 1, No. 782, in 1913.

69. Sydow, P. Pilze. Just's Bot. Jahr. **42, I:** 175. 1921.
Notes Petrak issued *Fusicladium saliciperdum*, Fl. Boh. et Mor. Exs. II, 1, No. 925, in 1914.

70. **Tubeuf, C.** Das Triebsterben der Weiden. Arb. Biol. Abth. Land. u. Forstw. Kaiserl. Gesundh. **2**: 567-70. 1902.
States the willow disease was first called to his attention in 1884 by Dr. Merck; gives description of the injury and discusses similarity to frost injury which Frank thought the fungus followed; copies original description of *Septoglœum saliciperdum*; discusses historical relationship to similar fungus on poplars and notes their differences and the right of the poplar fungus to the name *Fusicladium ramulosum*; renames the willow fungus *Fusicladium saliciperdum* Tub.; pictures spores of both species, the injured tips of willow twigs, as well as a cross section of a conidial sorus on *Salix pentandra*; reports *S. babylonica* and "other willows" as hosts; gives Ludwigs "Lehrbuch der niederen Kryptogamen" as reference for serious outbreak on willows in Burgundy reported by Vuillemin.

71. **Winter, G.** *Venturia chlorospora* Wint. *in litt.* de Thüm. Myc. Uni· No. 560. 1876.
Under above name issues specimens collected in Saxony on *Salix cinerea* in 1874; gives *Sphaeria chlorospora* Ces. and *Sphaerella chlorospora* Ces. et De Not. as synonyms.

72. **Winter, G.** *Venturia chlorospora* (Cesati). Rab. Krypt. Fl. 1^2: 436. 1887.
Gives synonomy, exsiccati, specific description and hosts but agrees with Rehm that under above name should be included what are now considered distinct species on Salix, Sorbus, Fraxinus, Pyrus, Ulmus, etc.

73. ***Fabricius, L.** Krankheiten der Nutzhölzer. Hollrung's Jahresb' Neuer. Leist. Geb. Pflanzenkr. **5**: 279-302. 1904 or 2?
According to Lind (No. 35, p. 520, 562) Fabricius treats of *Fusicladium saliciperdum* in this article on page 281.

74. ***Ludwigs.** Lehrbuck der niederen Kryptogamen.
According to Tubeuf (No. 70, p. 570) Ludwigs gives reference to a serious outbreak on willow in Burgundy reported by Vuillemin.

75. ***Ludwigs u. Schmidt, M.** Biol. Reichs. Land-Forstw., Flugblatt No. 81.
According to Appen (No. 15, p. 67) they state *Fusicladium saliciperdum* injures willow trees.

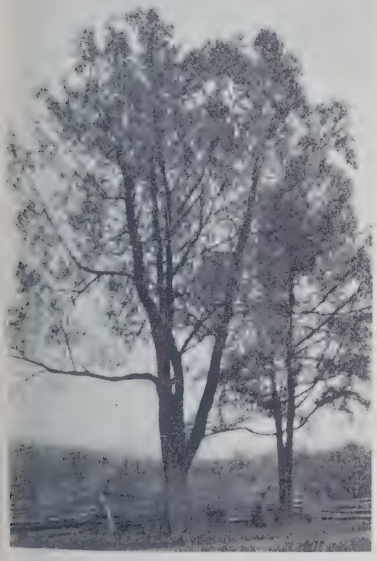
76. ***Salmon, E. S.** Rept. S. E. Agr. Coll., Wye, Economic Myc. **1907**: 17?
Given here on authority of Mrs. Allcock (*q. v.* No. 5), but we have been unable to verify from reference given by her.

77. ***Wolff, M.** Abt. Pflanzenkr. Kais. Wilh. Inst. Landw. Bromb., Flugblatt No. 15.
According to Appen (No. 15, p. 67) Wolff states that *Fusicladium saliciperdum* injures willow trees.

78. ***Undet. Author.** Abbauerscheinungen bei der amerikanischen Weide. Der Deutsche Korbweidenzüchter **1927**: 75-76. 1927.
See Review given under Anon. No. 14.

a. *Salix alba;* no disease.

b. *Salix* sp.; no disease.



c. *Salix* sp.; little disease.

d. *S. alba* var. *vitellina;* mod. disease.

WILLOWS WITH LITTLE OR NO DISEASED FOLIAGE.

PLATE X.

a. *Salix alba* var. *vitellina*.
Lawn trees, Norfolk.

b. *Salix alba* var. *vitellina*.
Street trees, Norfolk.

c. *Salix cordata*.
Bushes in swamp, Goshen.

d. *Salix alba* var. *vitellina*.
Trees along stream, Norfolk.

DISEASED WILLOWS (a, Photo, 1927; b-d, 1928) **FROM CONN.**

a. Street tree, Weymouth.

b. Pasture tree, Stewiacke.

c. Lighthouse Road, Digby.

d. Margaree, C. Breton.

DISEASED *Salix alba* var. *vitellina* **FROM NOVA SCOTIA.**
(a, c, Photos, 1927; b, d, 1928.)

PLATE XII.

a. New Haven, P. Edw. Isl.

b. Moncton, N. Brunswick.

c. Harrington, Me.

d. Salisbury Cove, Me.

DISEASED *Salix alba* var. *vitellina* **FROM CANADA AND MAINE**, 1928.

a. *Salix alba* var. *vitellina*, natural infection.

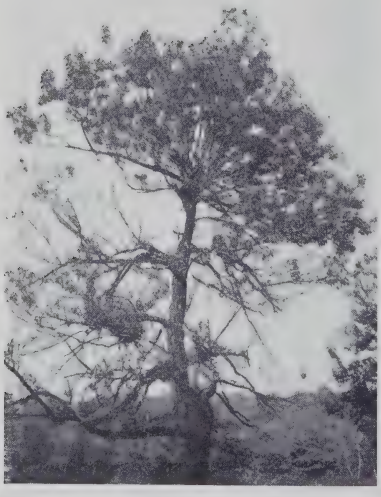
b. *Salix cordata*, artificially infected.

WILLOW LEAVES AND TWIGS SHOWING INJURY.

PLATE XIV.

a. Spray apparatus.

b. Spraying top of tree.



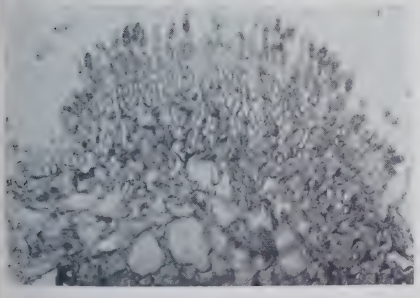
c. Sprayed tree.

d. Check, unsprayed tree.

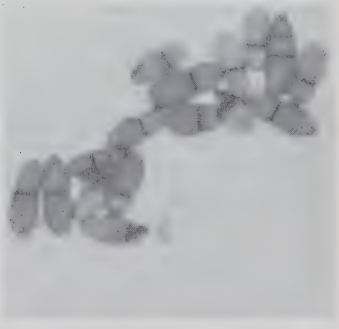
SPRAYING EXPERIMENTS AT NORFOLK, CONN., 1928.

a. Characteristic fruiting pustules on veins.

b. Culture.



c. Fruiting pustule.



d. Spores.

DETAILS OF, *Fusicladium saliciperdum*, **SCAB FUNGUS.**

(a, slightly; c, d, highly magnified).

PLATE XVI.

Inset, experimental plot. Main photo, details of one infection.

ARTIFICIAL INFECTION OF BASKET WILLOWS AT MT. CARMEL.

Bulletin 303 March, 1929

Connecticut Agricultural Experiment Station
New Haven, Connecticut

REPORT ON INSPECTION

OF

COMMERCIAL FEEDING STUFFS

1928

The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to other applicants as far as the editions permit.

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COMMERCIAL FEEDING STUFFS

E. M. Bailey.*

The Feed Law.

The text of the law relating to concentrated commercial feeding stuffs and of regulations made jointly by the Dairy and Food Commissioner and the Director of this Station for carrying out its provisions, are given in a special bulletin No. 60.[1]

Some essential provisions of the law and the regulations may be briefly restated here.

Exemptions. It is held that the law exempts from classification as concentrated commercial feeding stuffs, and therefore from registration, (1) roughages such as hays, straws, corn stover, ensilage and all materials containing over 60 per cent of water; (2) whole grains and mixtures thereof; (3) meals made from whole grains when not mixed with other materials or with each other; (4) feed ground from whole grains and sold by the manufacturer directly to the consumer; (5) feed ground from materials furnished by the consumer; or (6) feed mixed according to a formula furnished by the consumer, for his own use.

Under the provision of clause 6 above, a feed must be sold as a formula only, without a private brand name and without analysis. But a feed cannot be offered for general trade as a formula in order to avoid registration and the registration fee.

Labelling. All concentrated commercial feeding stuffs must be labelled either by a statement printed on the bag or upon a properly attached tag; except that in the case of cottonseed meal sold for fertilizer, or of any concentrated feeding stuff sold in bulk, a certificate which shall contain the information otherwise required to appear upon the bag or upon the tag, may be issued by the dealer in lieu thereof.

The law requires a statement of (1) the net weight of the feed contained in the package; (2) the name, brand or trademark under which the feed is sold; (3) name and address of the manufacturer or importer; (4) the minimum percentages of (a) crude protein and (b) crude fat, and the maximum percentage of (c) crude fiber contained in the feed; and (5) the separate ingredients of which the feed is composed.

While the law requires only a statement of the items enumerated above no objection will be raised to more complete statements of chemical composition.

---

*Analyses were made by Messrs. Nolan, Mathis and Walden; microscopic examinations by Mr. Shepard and Miss Yale; inspection and sampling by Mr. Churchill; and the compilations largely by Mrs. Vosburgh.

[1] Bull. Immediate Information No. 60, June, 1927.

Affixing tags. The use of wire or any metal in affixing tags to feed packages is prohibited by law.

Registration and registration fee. The law requires an annual registration of all concentrated feeds sold or offered for sale in this State. Registrations are to be made with the Connecticut Agricultural Experiment Station and beginning January 1st, 1928, the registration period is for the duration of the calendar year. The registration fee is fifteen dollars ($15.00), for each brand, a distinct brand name or a distinct analysis constituting a distinct brand.

Duties of manufacturers, jobbers and dealers. All concentrated commercial feeding stuffs must be registered annually on January 1st, or before they are offered for sale.

Manufacturers, jobbers or individuals shipping feeds into Connecticut will be expected to register their brands and pay the necessary fees thereon. Connecticut dealers should assure themselves that the brands they handle are properly registered and labelled. In case the manufacturer or jobber outside the State neglects or refuses to register, the dealer who handles such feeds will be held responsible for such registrations, registration fees and other legal requirements.

Dealers within the State who mix their own brands are responsible for the registration and proper labelling thereof.

Cottonseed meal. Cottonseed meal sold as a fertilizer is required to be registered under the terms of the fertilizer law; if sold also as a feeding stuff it is required also to be registered under the provisions of the feed law; if sold exclusively for one or the other of these purposes, it may be registered only under that law which applies.

Explanation of Terms Used in an Analysis of Feeding Stuff.

In registering feeding stuffs the law requires that the minimum percentages of crude protein and crude fat, and the maximum percentage of crude fiber, shall be given; that is, the registrant must guarantee that the feeds registered will contain *not less* than the stated percentages of crude protein and of crude fat and *not more* than the stated percentage of crude fiber.

The term *crude protein* denotes those nutrients which contain nitrogen, and is obtained by multiplying the percentage of total nitrogen in the feed by the factor 6.25.

The term *crude fat* denotes those substances which are soluble in ether and includes, besides fat, such non-fatty materials as chlorophyll and coloring matter.

The term *crude fiber* denotes the coarse, woody tissues characteristic of all forms of roughage and which are present in the outer coats of cereal and other fodder grains.

While the law requires only a statement of the three nutrients just defined, no objection is taken to more complete statements of composition, but such further statements, if given, must be correct. Thus, tags sometimes bear guaranties for nitrogen-free-extract and for carbohydrates.

The term *nitrogen-free-extract* denotes those nutrients of the starch and the sugar types. This group is never determined directly but is obtained by subtracting from 100 per cent the sum of the percentages of moisture, ash, crude protein, crude fiber and crude fat.

The term *carbohydrates* denotes the combined percentages of crude fiber and nitrogen-free-extract.

Registrations.

(*Late Registrations for the period* 1926–27.)

To the brands registered for 1926-27 in our last report should be added:

Beacon Milling Co., Inc., Cayuga, N. Y.
Beacon Broiler Feed

Chapin & Company, Chicago, Ill.
Ajax Horse Feed
Centaur Feed

Hennepin Mill Company, Minneapolis, Minn.
Ben Hur Pure Hard Wheat Red Dog
Ben Hur Hard Wheat Bran and Wheat Screenings
Ben Hur Hard Wheat Standard Middlings and Wheat Screenings
Ben Hur Hard Wheat Flour Middlings and Wheat Screenings
Ben Hur Fancy Mixed Feed

N. E. By-Products Corp., Lawrence, Mass.
Sterilized Feeding Bone Flour

Ralston Purina Company, St. Louis, Missouri.
Blue Checker Cow Chow
Purina Lamb Chow
Purina Sheep Fatena Cubes

St. Albans Grain Company, St. Albans, Vt.
Hygrade Sweetened Milk Ration

Syracuse Milling Company, Syracuse, N. Y.
Syragold Laying Mash with Buttermilk

(*For the period January 1st, 1928 to December 31st, 1928*)

One hundred and seventy-three firms and individuals have registered 828 brands of feeding stuffs. As required by Statute these registrations are listed as follows:

C. L. Adams Co., Woodbury, Conn.
Claco

Advance Milling Company, 309 South La Salle St., Chicago, Ill.
Advance Hominy Feed

E. T. Allen Company, Atlanta, Ga.
Atlas-Standard Cotton Seed Meal

American Agricultural Chemical Company, New Haven Sales Dept., New Haven, Conn.
"Protox Meat and Bone Scrap"
"Capital Meat and Bone Scrap"

American Linseed Company, 297 Fourth Ave., New York City.
Alinco Old Process Linseed Meal
Old Process Flaxseed Screenings Oil Feed

American Maize-Products Co., 41 East 42d St., New York City.
Cream of Corn Gluten Feed

American Milling Co., Peoria, Ill.
Amco Chick Grains
Amco Corn Feed Meal
Amco Egg Mash
Amco Egg Mash with Dried Buttermilk
Amco Horse Feed
Amco Intermediate Scratch Grains
Amco June Pasture Alfalfa & Molasses
Amco Scratch Grains (No. 1 Formula)
Amco Scratch Grains (No. 2 Formula)
Amco 12% Fitting Ration
Amco 20% Batch Mix
Amco 24% Batch Mix
Amco 20% National Dairy Ration
Amco 24% Dairy Ration (Flexible Formula)
Amco 24% Universal Dairy Ration

Arcady Farms Mfg. Co., 223 W. Jackson Blvd., Chicago, Ill.
Advanced Registry Dairy Feed
Arcady Besbet Laying Mash
Arcady Scratch Grains
Arco 24% Dairy Ration
Milkers Ready Ration
Peerless Milk Ration
Producer's 20% Ready Ration
Sweet 16 Dairy Feed
Wonder Dairy Ration
Wonder Horse & Mule Feed

Archer-Daniels Midland Co., Minneapolis, Minn.
Pure Old Process Linseed Meal 32%
Pure Old Process Linseed Meal 34%

Atlan Mfg. Co., 142 Logan Ave., Jersey City, N. J.
Diamond Pick Meat and Bone Scrap

Atlantic Coast Fisheries Corporation of N. Y., Groton, Conn.
"Atco"

E. W. Bailey & Co., Montpelier, Vt.
Capital Dairy Ration
Favorite Dairy Ration
Pennant Brand Stock Feed

Bay State Milling Co., Winona, Minn.
Wingold Diamond G Pure Hard Wheat Reddog
Wingold Fancy Pure Hard Wheat Mixed Wheat Feed
Wingold Pure Hard Wheat Bran
Wingold Pure Hard Wheat Fancy White Flour Middlings
Wingold Rye Middlings and Rye Screenings
Wingold Standard Hard Wheat Middlings and Wheat Screenings

Beach Soap Company, Lawrence, Mass.
Beach's Star Brand Beef Scraps

Beacon Milling Co., Inc., Cayuga, N. Y.
Auburn Dairy Feed
Auburn Scratch Feed
Beacon Broiler Feed
Beacon Calf Meal
Beacon Chick Feed
Beacon Dairy Ration
Beacon Developer Feed
Beacon Duck Breeders Mash
Beacon Duck Fattener
Beacon Duck Growing Mash
Beacon Duck Starter
Beacon Egg Mash with Buttermilk
Beacon Fleshing Mash with Buttermilk
Beacon Growing Mash
Beacon Hog Feed
Beacon Horse Feed
Beacon Laying Mash
Beacon Scratch Grains
Beacon Special Scratch Grains
Beacon Starting Mash
Beacon Sweet 24
Beacon "20"
Beacon Turkey Growing Feed
Cayuga Growing Mash
Cayuga Laying Mash with Buttermilk
Cayuga Stock Feed
Chariot Chick Feed
Chariot Developer Feed
Chariot Horse Feed

Belle Isle Creamery Company, Detroit, Michigan.
"Belle Isle Brand"

Ira W. Beers, Hamden, Conn.
Beers' Laying Mash
Beers' Scratch Feed

Blatchford Calf Meal Company, Waukegan, Ill.
Blatchford's Calf Meal
Blatchford's Chick Mash with Buttermilk

Amos D. Bridges' Sons, Inc., Hazardville, Conn.
Success Dairy Ration

The Bristol Grain & Supply Co., Bristol, Conn.
Bristol Laying Mash
Bristol Scratch Feed

F. W. Brode Corp., Memphis, Tenn.

Owl Brand 36% Prime Cotton Seed Meal
Owl Brand 41% Prime Cotton Seed Meal
Owl Brand 43% Prime Cotton Seed Meal

C. Buckingham & Co., Inc., Southport, Conn.

C. B. Dairy Feed
C. B. Growing Mash
C. B. Mash

C. E. Buell, Inc., Boston, Mass.

"Buell-Boston" Dried Skim Milk

C. W. Burckhalter, Inc., 233 Broadway, New York City

Burck Brand Powdered Skim Milk

C. W. Campbell Co., Stonington, Conn.

Campbell Horse Feed
Egg-O Dry Mash
Egg-O Scratch
No-Botheration Dairy Ration
Provender

The Canada Linseed Oil Mills, Limited, Montreal, Canada

"Maple Leaf"

Chapin & Company, Chicago, Ill.

Ajax Dairy Ration 16%
Ajax Dairy Ration 20%
Ajax Dairy Ration 24%
Ajax Horse Feed
Centaur Fitting Ration
Chapin Kernels Egg Mash
Chapin Grow All
Chapin Kernels Lay All
Chapin Kernels Start All
Green Diamond Brand Cottonseed Meal
Unicorn Chick Starter
Unicorn Coarse Chick
Unicorn Dairy Ration
Unicorn Egg Mash with Buttermilk
Unicorn Fine Chick
Unicorn Growing Mash with Buttermilk
Unicorn Horse Feed
Unicorn Pig Meal
Unicorn Scratch Feed

Clinton Corn Syrup Refining Company, Clinton, Iowa.

Clinton Corn Gluten Feed

The Coles Company, Middletown, Conn.

Fortune Egg Mash with Dried Buttermilk
Fortune Growing Feed
Fortune Scratch Feed
Fortune Stock Feed
Fortune 20% Molasses Dairy Feed
Fortune 24% Molasses Dairy Feed

Collis Products Company, Clinton, Iowa

Collis Process Pure Dried Buttermilk

The G. E. Conkey Co., Cleveland, Ohio

Conkey's All Grain Horse and Mule Feed (with Molasses)
Conkey's Chick Grains
Conkey's Diamond Horse Feed
Conkey's Fattening Mash without Buttermilk
Conkey's Growing Grains
Conkey's (The Original) Growing Mash with Buttermilk
Conkey's Gecco Chick Grains
Conkey's Gecco Egg Mash
Conkey's Gecco Growing Grains
Conkey's Geccofat with Buttermilk and Y-O Cod Liver Oil, Yeast, Soy-bean Oil Meal, Wheat Middlings
Conkey's Gecco Growing Mash
Conkey's Gecco Scratch Grains
Conkey's Gecco 20% Dairy Ration
Conkey's Horse Feed with Alfalfa and Molasses
Conkey's (The Original) Laying Mash with Buttermilk
Conkey's Scratch Grains
Conkey's (The Original) Starting Feed with Buttermilk
Red Seal Scratch Grains
Red Seal 16% Dairy Ration
Superior Scratch
Conkey's 24% Dairy Ration

The Conn. Fat Rendering & Fertilizer Corp., West Haven, Conn.

Conn. Fat Rend. & Fertz. Corp. Meat and Bone

Consolidated Rendering Company, Boston, Mass.

Corenco Bone Meal, An All Animal Feed For Cattle, Hogs and Poultry

Copeland Flour Mills Limited, Midland, Ontario, Canada

Dandy Bran
Dandy Shorts

Corn Products Refining Company, 17 Battery Place, New York City

Buffalo Corn Gluten Feed
Co-Pro-Co Horse and Mule Feed
Diamond Corn Gluten Meal

C. A. Cowles, Plantsville, Conn.

C. A. Blue Seal Laying Mash
Cowles Dairy Ration
Cowles Scratch Feed

Chas. M. Cox Co., Boston, Mass.

Lakewoods Wheat Bran

Crosby Milling Company, Brattleboro, Vt.

Crosby's Balanced Ration
Crosby's Egg Mash
Crosby's Mixed Feed
Crosby's Ready Ration
Crosby's Scratch Feed
Crosby's Stock Feed
Crosby's 22% Dairy Feed

R. G. Davis & Sons, New Haven, Conn.
Basic Dairy Ration
Davis Horse Feed
Davis Scratch Feed
Davis Stock Feed
20% Open Formula Dairy Ration

Decatur Milling Company, Decatur, Ill.
Homco Brand Hominy Feed

Delaware Mills, Inc., Deposit, N. Y.
Delaware Chick Grains
Delaware Chick Starting Mash (With Dried Buttermilk)
Delaware Dairy Feed
Delaware Growing Mash (with Dried Buttermilk)
Delaware Laying Mash (with Dried Buttermilk)
Delaware Scratch Grains
Delaware Stock Feed
Delco 20% Dairy Feed
Indian Laying Mash (with Dried Buttermilk)
Indian Scratch Grains

The Denver Alfalfa Milling & Products Co., Lamar, Colorado
Alfalfa Meal

The Devon Coal & Ice Company, Devon, Conn.
Devon Dairy Ration
Devon Laying Mash
Devon Sweet Stock Feed

The Dewey Bros. Co., Blanchester, Ohio
Corn Distillers Dried Grains

The Dominion Flour Mills, Limited, Montreal, Canada
Wheat Bran
Wheat Shorts

Dry Milk Company, 15 Park Row, New York City
Chikora

Duluth-Superior Milling Co., Duluth, Minn.
Duluth Imperial Wheat Bran
Boston Mixed Feed

Eastern Grain Co., Bridgewater, Mass.
Dried Skim Milk Powder

East Coast Trading Company, Baltimore, Md.
E-C Pure Fish Meal

Eastern States Farmers' Exchange, 33 Lyman St., Springfield, Mass.
Eastern States Cottonseed Meal 41%
Eastern States Egg Mash Open Formula
Eastern States Fitting Ration Open Formula
Eastern States Fulpail Dairy Ration Open Formula
Eastern States Horse Feed Open Formula
Eastern States Milk Egg Mash Open Formula
Eastern States Milkmore Dairy Ration Open Formula
Eastern States Scratch Grains Open Formula (1927 Formula)
Eastern States Scratch Grains Open Formula (Old Formula)

S. T. Edwards & Co., Inc., 110 So. Dearborn St., Chicago, Ill.
Butterfly Dry Skim Milk

Elmore Milling Company, Inc., Oneonta, N. Y.
Chixsaver
Elmore Egg Mash
Elmore Growing Mash
Elmore's Hog Ration
Elmore Horse Feed with Molasses
Elmore (Storrs' Formula) Laying Mash
Elmore's Makemgrow Little Pig Ration
Elmore Milk Grains
Elmore Scratch Feed
Elmore Stock Feed
Elmore "Three Point" Calf Meal
Elmore-Waldorf Formula
Elmore's "Xtragood" Wheat Feed with Ground Screenings
Emco Feed
Otsego Economy Ration

John W. Eshelman & Sons, Lancaster, Pa.
Eshelman's Baby Chick Starter
Eshelman's Chick Feed
Eshelman's Conestoga 18 Dairy Feed
Eshelman's Fattening Mash
Eshelman's Golden Rod 25 Dairy Feed
Eshelman's Growing Mash
Eshelman's Lancaster 60 Horse Feed
Eshelman's Lancaster Stock Feed
Eshelman's Lancaster 20 Dairy Feed
Eshelman's Laying Mash
Eshelman's Open Formula 20 Dairy Feed
Eshelman's Pennsy 16 Dairy Feed
Eshelman's Red Rose 85 Horse Feed
Eshelman's Red Rose 24 Dairy Feed
Eshelman's Scratch Feed
Eshelman's Stock Feed
Eshelman's Thorobred Horse Feed
Eshelman's Wheat Flour Middlings
Eshelman's Wheat Red Dog
Eshelman's Susquehanna Dairy Feed
Imperial Scratch Feed
Lancaster Scratch Feed
Liberty Horse Feed
Pennsy Scratch Feed

Evans Milling Company, Indianapolis, Indiana
Emco Hominy Feed

Fairchild Milling Company, Cleveland, Ohio
Wheat Bran
Standard Middlings
Special Fine Wheat Middlings

The Fairfax Milling Company, Minn.
Red Wing Special Reddog

The Fairmont Creamery Company, Omaha, Neb.
Fairmont's Better Pure Flake Buttermilk

Farmers Feed Company, 532 East 76th St., New York City
"Bull Brand" Dried Brewers Grains

Flory Milling Co., Inc., Bangor, Pa.
Blue Mountain Horse Feed
Corn Feed Meal
Cream-O-Milk Dairy Feed
Flory's Baby Chick Feed
Flory's Chick Starter
Flory's Dairy Feed
Flory's Egg Mash
Flory's Growing Mash
Flory's Horse Feed
Flory's Intermediate Chick Feed
Flory's Scratch Feed
Flory's Wheat Mixed Feed
Golden Egg Scratch Feed
National Cow Feed
Special Stock Feed
Sunray Scratch Feed
Vio Horse Feed

A. W. Forbes, East Haven, Conn.
Chic Mash
Dairy Ration
R-Own Laying Mash
Scratch Feed

The L. T. Frisbie Company, New Haven, Conn.
Frisbie's Poultry Feed 45%
Frisbie's Poultry Feed 55%

Grain Belt Mills Company, So. St. Joseph, Mo.
Bronco Horse and Mule Feed
Hunter Horse and Mule Feed

D. H. Grandin Milling Company, Jamestown, N. Y.
Grandin's Baby Chick Starter with Buttermilk
Grandin's Growing Feed
Grandin's Laying Mash with Buttermilk
Grandin's Screened Scratch Feed
Grandin's 24% Balanced Dairy Ration

Hales & Hunter Company, 327 So. La Salle St., Chicago, Ill.
College Horse Feed
H & H Dairy Feed
Kingfalfa Horse Feed
Pioneer Hog Feed
Red Comb Chick Starter
Red Comb Egg Mash
Red Comb Growing Mash
Red Comb Scratch Feed, No Grit

William Hamilton & Son, Inc., Honeoye Falls, N. Y.
Wheat Bran
Wheat Middlings

The Hecker H-O Company, Inc., Buffalo, N. Y.
Algrane Steam-Cooked Chick Feed
Re-Ground Oat Feed

Hecker-Jones-Jewell Milling Co., 40 Corlears St., New York City
Choice Wheat Bran
H Wheat Middlings
Red Dog Flour
(Buffalo Mill)
Choice Wheat Bran
Wheat Flour Middlings
Wheat Red Dog Flour
Wheat Standard Midds
Extra Heavy Wheat Mixed Feed

Hennepin Mill Company, 200 Chamber of Commerce, Minneapolis, Minn.
Ben Hur Fancy Mixed Feed
Ben Hur Hard Wheat Bran and Wheat Screenings
Ben Hur Hard Wheat Flour Middlings and Wheat Screenings
Ben Hur Hard Wheat Standard Middlings and Wheat Screenings
Ben Hur Pure Hard Wheat Red Dog

The J. C. Hubinger Bros. Co., Keokuk, Iowa
Ke OK uK Corn Gluten Feed

L. W. Hudson, Windsor, Conn.
Hudson's Cow Feed
Hudson's Developing Mash
Hudson's Laying Mash

Humphreys-Godwin Company, Memphis, Tenn.
Bull Brand Cottonseed Meal
Danish Brand Cottonseed Feed
Dixie Brand Cottonseed Meal

Imperial Grain & Milling Co., Toledo, Ohio
Imperial Steam Cooked Feed

International Agricultural Corp., Columbus, Ga.
Zenith 41% Cotton Seed Meal

International Milling Company, Minneapolis, Minn.
Blackhawk Pure Wheat Bran
Blackhawk Wheat Flour Middlings
Blackhawk Wheat Low Grade Flour
Blackhawk Wheat Standard Middlings

The Kansas Flour Mills Corporation, Kansas City, Missouri
Big Flake Pure Wheat Bran

Kasco Mills, Inc., Waverly, N. Y.
Apex Milk Maker
Beatsall Milk Grains

Kellogg Company, Battle Creek, Michigan
White Hominy Feed

Kelloggs & Miller, Inc., Amsterdam, N. Y.
Pure Old Process Linseed Oil Meal

Spencer Kellogg & Sons, Inc., Buffalo, N. Y.
Kellogg's Pure Old Process Linseed Meal 32%
Kellogg's Pure Old Process Linseed Meal 34%

H. H. King Flour Mills Co., Minneapolis, Minn.
"Gold Mine" Feed

King Midas Mill Company, Minneapolis, Minn.
Wheat Standard Middlings and Ground Wheat Screenings

Chas. A. Krause Milling Co., Milwaukee, Wis.
Badger Horse and Mule Feed
Badger 16½% Sweet Dairy
Badger White Hominy Feed
Blue Top Chick Feed, No Grit
Blue Top Egg Mash
Blue Top Scratch Feed, No Grit
Cream City Scratch Feed, No Grit

S. F. Labieniec, Kensington, Conn.
Dry Mash

The Larrabee Flour Mills Company, Kansas City, Missouri
Wheat Bran and Wheat Screenings

The Larrowe Milling Company, Detroit, Michigan
Dried Beet Pulp
Dried Molasses-Beet Pulp
Larro Brand Choice Cottonseed Meal
Larro Chick Grains
Larro Chick Starter
Larro Egg Mash
Larro Growing Grains
Larro Growing Mash
Larro Hog Feed
Larro Scratch Grains
Larro—The Ready Ration for Dairy Cows

C. W. Lines Co., New Britain, Conn.
Homestead Dry Mash
Homestead Scratch Feed
Mill Pride Fancy Scratch Feed
Mill Pride Dairy Ration
Mill Pride Milk Mash

Litchfield County Co-Operative Association, Torrington, Conn.
Common Sense Dairy Ration
Common Sense Growing Mash
Common Sense Laying Mash
Common Sense Scratch Feed

Long Hill Feed Store, Long Hill, Conn.
Square Deal Buttermilk Laying Mash
Square Deal Dairy Ration

Louisville Milling Co., Inc., Louisville, Ky.
Sonny South Hominy Feed

L. B. Lovitt & Company, Memphis, Tenn.
"Lovit Brand" 36% Cottonseed Meal
"Lovit Brand" 41% Cottonseed Meal
"Lovit Brand" 43% Cottonseed Meal

E. Manchester & Sons, Winsted, Conn.

Buttermilk Mash
Red Star Dairy Feed
Red Star Egg Mash
Red Star Flour Middlings
Red Star Mixed Feed
Red Star Scratch Feed

The Mann Bros. Co., Buffalo, N. Y.

33% Protein Pure Old Process Linseed Meal

Maritime Milling Co., Inc., Buffalo, N. Y.

Bull Brand Chick Feed
Bull Brand Chick Starter (with Dried Buttermilk)
Bull Brand Chop Feed
Bull Brand Dairy Ration
Bull Brand Dairy Ration (Sweetened)
Bull Brand Developing Feed
Bull Brand Growing Mash (with Dried Buttermilk)
Bull Brand Heavy Mixed Feed
Bull Brand Horse Feed (with Molasses)
Bull Brand Laying Mash (with Dried Buttermilk)
Bull Brand Scratch Feed
Bull Brand Stock Feed
Bull Brand Wheat Flour Middlings
Daisy Scratch Feed
Hi-Test Dairy Feed (Sweetened)
Hi-Test Stock Feed (Sweetened)
Jersey Dry Mash (with Dried Buttermilk)
Marmico Dairy Feed (with Molasses)
Red-E-Mixt Dairy Feed (Sweetened)
Red-E-Mixt Egg Mash

A. G. Markham & Company, Springfield, Mass.

Cooked Meat and Bone Scrap
Special Cooked Meat and Bone Scrap

The George E. Marsh Company, Lynn, Mass.

Marsh's Pure Ground Scraps for Poultry

E. J. Martenis Grain Co., L-3 Produce Exchange, New York City

Alco Dried Distillers Grains
Alco Dried Brewers Grains

Meech & Stoddard, Inc., Middletown, Conn.

Red Wing Dairy Ration
Red Wing Mixed Feed
Red Wing Molasses Horse Feed
Red Wing Scratch Feed
Red Wing Special Buttermilk Chick Starter
Red Wing Special Buttermilk Growing Feed
Red Wing Special Buttermilk Laying Mash
Red Wing Special Chick Feed
Red Wing Special Dairy Feed
Red Wing Special Intermediate Chick Feed
Red Wing Stock Feed

Memphis Cottonseed Products Company, Memphis, Tenn.

Durham Brand Thirtysix Cottonseed Meal
Durham Brand Fortyone Cottonseed Meal
Durham Brand Fortythree Cottonseed Meal

Middleport Flour Mills, Inc., Middleport, N. Y.
Angelus Wheat Bran
Angelus Wheat Middlings

Miner-Hillard Milling Co., Wilkes-Barre, Pa.
No. 1 Scratch Feed
Rye Middlings
"1795" Steam Cooked Corn and Oats
Steam Cooked Hominy Feed

Minneapolis Milling Company, Minneapolis, Minn.
Wheat Bran with Ground Screenings

Geo. Q. Moon & Co., Inc., Binghamton, N. Y.
Moon's Developing Grains
Moon's Fresh Ground Mixed Feed
Moon's Fresh Ground White Middlings
Moon's Growing Mash
Moon's Hominy Feed
Moon's Laying Mash with Dried Buttermilk
Moon's 24% Dairy Ration
Moon's Scratch Feed
Moon's Stock Feed
Moon's Wheat Bran
Moon's X Dairy Ration

Moran-Patton Co., 234 Cedar St., New Haven, Conn.
C-B Mash

Fred C. Morse, Guilford, Conn.
Old Mill Buttermilk Laying Mash
Old Mill Dairy Ration
Old Mill Growing Mash with Milk
Old Mill Laying Mash
Old Mill Provender
Old Mill Scratch Feed

Jas. F. Morse & Co., Somerville, Mass.
Morse's Meat Scraps for Poultry 40%
Morse's Meat Scraps for Poultry 50%

The National Milling Co., Toledo, Ohio
National Feed
Osota Feed
Pure Wheat Bran (extra broad)

Nebraska Consolidated Mills Co., 627-630 Grain Exchange Building, Omaha, Nebraska
Pure Flour Middlings
Pure Wheat Bran
Pure Winter Wheat Shorts

New England By-Products Corp., 20 West St., Lawrence, Mass.
Blue Seal Meat Scraps
Gold Seal Dried Skim Milk
White Seal Meat Scraps

Newman Bros. Grain Co., Rochester, N. Y.

Corn Feed Meal
Lay She Will Egg Mash with Buttermilk
Mystic Laying Mash
Mystic Milk Maker
Mystic Scratch Grains
Newman's Best Dairy Feed

Newsome Feed & Grain Company, Pittsburgh, Pa.

Palmo Midds

Newton Feed Company, Milwaukee, Wisconsin

Institutional 20% Sweet Dairy Feed
Institutional 24% Sweet Dairy Feed
Newtrio Growing & Fitting Ration
Newtrio 16% Dairy Ration
Newtrio 20% Dairy Ration
Newtrio 24% Dairy Ration

Niagara Falls Milling Company, Niagara Falls, N. Y.

Niagara Choice Wheat Bran
Niagara Choice Wheat Middlings

N. W. Consolidated Milling Company, Minneapolis, Minn.

Planet Feed
Pure Wheat Bran
Wheat Flour Midds with Ground Screenings N. E. M. R.
Wheat Mixed Feed and Ground Screenings N. E. M. R.
Wheat Standard Midds, with Ground Screenings not exceeding Mill Run
X X X Comet

Norton Tallow Co., Somerville, Mass.

Norton's High Grade Meat and Bone Poultry Food

Nowak Milling Corporation, Hammond, Indiana

Cream O Lene Dairy Feed
Domino Baby Chick Starter with Buttermilk
Domino Butterine Dairy Feed
Domino Chick Feed
Domino Developing Feed
Domino Growing Mash with Buttermilk
Domino Hog Feed
Domino Horse Feed with Alfalfa
Domino Laying Mash with Buttermilk
Domino Pep-O-Lene Horse Feed
Domino Scratch Feed
Domino 32% Protein Mixed Dairy Feed
Domino 24½% Dairy Feed
Domino Vim O Lene Horse Feed
Export Scratch Feed
Fidelity Dairy Feed
Fidelity Scratch Feed
Fidelity Stock Feed
Hammond Dairy Feed
Marathon All Mash Chick Starter
Marathon Chick Feed
Marathon Dairy Feed
Marathon Horse Feed
Marathon Laying Mash with Buttermilk
Marathon Scratch Feed
Union Dairy Feed

Ogilvie Flour Mills Co. Ltd., Montreal, Canada

Ogilvie's Oat Feed
Ogilvie's Wheat Bran
Ogilvie's Wheat Shorts

Ontario Milling Company, Inc., Oswego, N. Y.

Aunt Mary's Chick Starting Mash with Dried Buttermilk
Aunt Mary's Egg Mash with Dried Buttermilk
Aunt Mary's Scratch Feed
Big Value Dairy Feed
Oswego Egg Mash with Meat and Bone
Oswego Scratch Feed
Uncle John's Stock Feed
Uncle John's 24% Cream Pot Ration

S. V. Osborn Estate, Branford, Conn.

Osborn Mash
Osborn Provender
Osborn Scratch

Park & Pollard Co., Buffalo, N. Y.

Arlington Horse Feed
Baby Buster Chick Feed
Belmont Horse Feed
Bet-R-Milk 20% Ration
Bidwell Dry-Mash (Black Rock Milling Corp.)
Bidwell Scratch Feed (Black Rock Milling Corp.)
Bonnie Booster
Chelsea Horse Feed
Corn and Oats ½ and ½
Feed Meal
Go Tu It Hog Ration
Growing Feed
Herdhelth 16% Ration
Intermediate Chick Feed
Lay or Bust Dry-Mash
Leghorn Special Dry-Mash
Milkade Calf Meal
Milk-Maid 24% Sweetened Dairy Ration
Overall 24% Dairy Ration
Over the Top Scratch
Red Ribbon Chick Feed
Red Ribbon Scratch Feed
The Park & Pollard Co. Stock Feed
Top Notch 16% Ration
Wheat Flour Middlings

Pecos Valley Alfalfa Mill Co., Hagerman, New Mexico

Alfalfa Leaf Meal

Pillsbury Flour Mills Company, Minneapolis, Minn.

Palisade Chick Feed, No Grit
Palisade Scratch Feed, No Grit
Pillsbury's Chick Grains, No Grit
Pillsbury's Dairy Ration
Pillsbury's Durum Wheat Bran and Screenings
Pillsbury's Egg Mash with Buttermilk
Pillsbury's Fancy Mixed Feed and Screenings
Pillsbury's Growing Mash with Buttermilk 16%
Pillsbury's Growing Mash with Buttermilk 17%

Pillsbury's Hard Wheat A Middlings and Screenings
Pillsbury's Hard Wheat Bran and Screenings
Pillsbury's Hard Wheat Standard B Middlings and Screenings
Pillsbury's Rye Middlings and Screenings
Pillsbury's Scratch Grains
Pillsbury's Starting Feed with Buttermilk
Pillsbury's Wheat Bran and Screenings
Pillsbury's Wheat Gray Shorts
Pillsbury's X X Daisy

Pittsburgh Plate Glass Co., Newark, N. J.

Red Wing Linseed Meal 32%
Red Wing Linseed Meal 34%

The Frank S. Platt Co., 450 State St., New Haven, Conn.

Platco Laying Mash
Platco Perfection Grain Mixture

Postum, Inc., Battle Creek, Michigan

Burt's Dairy Feed
Burt's Hominy Feed

W. N. Potter & Sons, Inc., Greenfield, Mass.

A. D. P. 24% Dairy Ration
Puritan Dry Mash
Puritan Growing Feed
Puritan Scratch Feed

Pratt Food Co., Hammond, Indiana

Armour's 24% Dairy Feed
Cak Cak Laying Mash with Buttermilk, Oat Meal, Fish, Meat, etc.
Iroquois Poultry Mash
Iroquois Scratching Grains
Pratt's Baby Chick Food with Buttermilk
Pratt's Circle A Chick Scratch Feed
Pratt's Circle A Large Scratch Feed
Pratt's Supreme Chick Scratch Feed
Pratt's Supreme Dairy Ration
Pratt's Supreme Fattening Mash with Buttermilk
Pratt's Supreme Growing Mash with Buttermilk
Pratt's Supreme Intermediate Scratch Feed
Pratt's Supreme Laying Mash with Buttermilk
Pratt's Supreme Stock Feed
Pratt's Sweet 24% Dairy Ration
Pratt's Utility Horse Feed
Pratt's Utility Large Scratch Feed
Pratt's Victory Chick Scratch Feed
Pratt's Victory Intermediate Scratch Feed.
Pratt's Victory Large Scratch Feed
Pratt's Victory Laying Mash with Buttermilk
Pratt's White Hominy Feed

H. C. Puffer Company, Springfield, Mass.

Egg-Em-On Growing Feed
Egg-Em-On Laying Mash
Egg-Em-On Laying Mash
Producer Dairy Feed

The Quaker Oats Company, 80 East Jackson St., Chicago, Ill.

Banner Feed
Bell Cow Bran
Bell Cow Shorts
Big Egg Scratch Grains, No Grit
Buckeye Feed
Hominy Feed (Aunt Jemima Mills Branch)
Horse Power Feed
Quaker Big "Q" 20% Protein Dairy Ration
Quaker Boss 24% Protein Dairy Ration
Quaker Ful-O-Pep Chick Starter
Quaker Ful-O-Pep Coarse Chick Feed
Quaker Ful-O-Pep Egg Mash
Quaker Ful-O-Pep Fine Chick Feed
Quaker Ful-O-Pep Growing Mash
Quaker Ful-O-Pep Scratch Grains
Quaker Green Cross Horse Feed
Quaker Pig-N-Hog Meal
Quaker Schumacher Feed
Quaker 16% Protein Dairy Ration
Quaker Sugared Schumacher Feed
Richford Provender
Richford White Diamond Stock Feed
Schumacher Calf Meal
Schumacher Little Chick Feed, No Grit
Schumacher Scratch Grains, No Grit
Sugared Vim Feed
Vim Feed
White Hominy Feed
White Star Stock Feed, Fine
White Star Stock Feed, Coarse
Yellow Hominy Feed

Ralston Purina Company, St. Louis, Mo.

Buffalo Purina Bulky Las Feed
Corn Feed Meal
Fine Ground Green Poultry Alfalfa Meal
Protena Dairy Feed
Purina Baby Chick Chow Feed
Purina Blue Checker Cow Chow Feed
Purina Buffalo Green Checker 24% Cow Chow Feed
Purina Calf Chow Feed
Purina Chicken Chowder Feed containing Charcoal and Mineral
Purina Chicken Fat Chow Feed
Purina Chicken Fatena Feed
Purina Chick Grow Chow Feed Containing Bone Meal and Lime Stone
Purina Chick Growena Feed containing Charcoal and Mineral
Purina Chick Startena Feed containing Charcoal and Mineral
Purina Cow Chow Feed
Purina Grainola Feed
Purina Hen Chow Feed
Purina Hog Fatena Feed containing Charcoal
Purina Intermediate Hen Chow Feed
Purina Lamb Chow Feed containing Charcoal
Purina Omolene Feed
Purina Orange Checker Cow Chow
Purina Pig Chow Feed containing Charcoal

Purina Red Checker 34% Cow Chow Feed
Purina Rolled Oats for Feeding Purposes (steam cooked)
Purina Special Steer Fatena Feed containing Charcoal
Winner Scratch Feed

John Reardon & Sons Company, Cambridge, Mass.
Register Brand 55%
Register Brand 45%

Red Wing Milling Company, Red Wing, Minn.
Red Wing Special Wheat Bran

Robin Hood Mills Limited, Moose Jaw and Calgary, Canada
Superior Pure Wheat Bran
Superior Pure Wheat Shorts

Rockville Grain & Coal Company, Rockville, Conn.
Diamond Chick Feed
Diamond Laying Mash
Diamond 85% Horse Feed
Diamond Scratch Feed
Diamond 24% Dairy Ration

The Rogers & Hubbard Company, Portland, Conn.
Rogers & Hubbard's Edible Bone Flour for Cattle and Poultry

Fred H. Rolf, Inc., Guilford, Conn.
Hubbard's Egg Producer
Rolf's Chic Grains
Rolf's Chic Mash
Rolf's Scratch Grains

Royal Milling Company, Great Falls, Montana
Dependable Rex Hard Wheat Mixed Feed and Wheat Screenings

Russell-Miller Milling Co., Minneapolis, Minn.
Alta Hard Wheat Middlings
Hard Wheat Occident Bran
Hard Wheat Occident Mixed Feed

Russia Cement Co., Gloucester, Mass.
Chic-Chuk, "The Ideal Concentrated Poultry Food"

Chas. Schaefer & Son, 304 Meserole St., Brooklyn, N. Y.
Honeysuckle Horsefeed

Seymour Grain & Coal Co., Seymour, Conn.
See More Egg Mash Buttermilk
See More Egg Scratch Feed
See More Milk Dairy Feed

The Shelton Feed Co., Inc., Shelton, Conn.
Nelson's Laying Mash
Nelson's Mixed Chicken Feed

Winchell Smith, Inc., Farmington, Conn.
Mill Streams "Boomerang" Dairy Feed
Mill Streams "Fortune Hunter" Scratch Grains
Mill Streams "Lightnin" Laying Mash
Mill Streams "Twenty Percent" Dairy Ration

Southwestern Milling Co., Inc., Kansas City, Missouri
Red Turkey Pure Wheat Bran

Spratt's Patent (Am.) Limited, Newark, N. J.
Spratt's Chicgrain
Spratt's Mash Food with Buttermilk

Springfield Rendering Company, Springfield, Mass.
Springfield Ground Meat Scraps

Standard Milling Company of Canada Limited, Toronto, Ontario, Canada
Bran
Shorts

A. E. Staley Manufacturing Company, Decatur, Ill.
Staley's Corn Gluten Feed

John T. Stanley Co., Inc., 642 West 30th St., New York City
Stanley's Meat and Bone Scrap

D. A. Stickell & Sons, Inc., Hagerstown, Md.
Blue Ridge Egg Mash
Blue Ridge Scratch Grains
Victor Scratch Grains

David Stott Flour Mills, Inc., Detroit, Mich.
Pennant Middlings and Wheat Screenings

Chas. M. Struven & Co., Baltimore, Md.
Struven's Fish Meal

St. Lawrence Flour Mills Co., Montreal, Que., Canada
Bran

St. Albans Grain Company, St. Albans, Vt.
Brewers' Dried Grains
Charlestock
Hygrade Sweetened 16 Milk Ration
Hygrade Sweetened Milk Ration
King Baby Chick Food containing Buttermilk
King Chick Feed
King Dairy Feed with Beet Pulp
King Growing Feed containing Dried Buttermilk and Beef Scraps
King Intermediate Chick Feed
King Mash Feed containing Buttermilk, Fish and Meat Scraps
King Scratch Feed
King Stock Feed
King 22% Protein Milk Ration Sweetened
Paragon Dairy Feed
Paragon Dairy Feed Sweetened
Paragon Hominy Feed
Paragon Scratch Feed
Wirthmore All Grain Chick Feed (Fine Chick Scratch)
Wirthmore Buttermilk Baby Chick Food
Wirthmore Certified Scratch Feed
Wirthmore Dairy Feed with Beet Pulp

Wirthmore Dairy Feed with Beet Pulp Sweetened
Wirthmore Flour Middlings
Wirthmore Growing Feed with Dried Buttermilk and Beef Scraps
Wirthmore Hog Feed
Wirthmore Horse Feed
Wirthmore Intermediate Chick Feed (Coarse Chick Scratch)
Wirthmore Laying Mash with Buttermilk
Wirthmore Pig Feed
Wirthmore Poultry Green
Wirthmore Scratch Feed
Wirthmore 16% Dairy Feed Sweetened
Wirthmore Stock Feed
Wirthmore 20% Dairy Feed
Wirthmore 20% Dairy Feed Sweetened
Wirthmore 25% Balanced Ration Sweetened
Wirthmore 25% Protein Balanced Ration
Wirthmore Wheat Feed
Wirthmore Wheat Reddog

Syracuse Milling Company, Syracuse, N. Y.

Jordan Horse Feed with Molasses
Onondaga Dairy Feed
Onondaga Scratch Grains
Symco Scratch Grains
Syragold Chick Starter
Syragold Dairy Feed
Syragold Egg Mash
Syragold Feed Meal
Syragold Flour Middlings
Syragold Ground Corn and Oat Feed
Syragold Growing Mash
Syragold Horse Feed with Molasses
Syragold Laying Mash with Buttermilk
Syragold Milk Ration
Syragold Scratch Grains
Syragold Stock Feed

D. L. Talcott, Torrington, Conn.

Talcott's Economy Dairy Ration

Thomaston Supply Co., Thomaston, Conn.

Thomaston Scratch Grains
Thomaston Dairy Ration
Thomaston Egg Mash

Tioga-Empire Feed Mills, Inc., Waverly, N. Y.

Chicatine
Derby Corn and Oat Feed
Derby Meal
Derby Scratch Feed
Egatine
E-Gee Dairy Feed
E-Gee Laying Mash
E-Gee Stock Feed
Neverfail Horse Feed
Neverfail Scratch Grains
Red Brand Tioga Dairy Feed
Tioga-Bran and Molasses

Tioga Calf Food
Tioga Chick Grains
Tioga Growing Grains
Tioga Growing Mash
Tioga Laying Food
Tioga Poultry Grains
Waverly Flour Wheat Middlings
White Brand Tioga Dairy Feed

Traders Feed & Grain Company, Inc., Buffalo, N. Y.
Bonny Hard Wheat Bran and Screenings

Ubiko Milling Company, Cincinnati, Ohio
Ubiko Union Grains 20% Sweet Dairy Ration
Ubiko Union Grains 24% Sweet Dairy Ration
Union Grains Ubiko Biles Ready Dairy Ration

Union Sales Corporation, Columbus, Indiana
Union Corn Gluten Feed

Upper Hudson Rye Flour Mills, Inc., Troy, N. Y.
Rye Feed

Van Iderstine Company, Railroad and Greenpoint Aves., Long Island City, N. Y.
Vico High Protein Meat Scrap for Poultry

Vitality Mills, Inc., Chicago, Ill.
Advance Dairy Feed
Advance Scratch, No Grit
"77" Scratch Feed, No Grit
"77" Stock Feed
Special Rosebro Horse Feed
Vitality Chick Starter
Vitality Coarse Chick Scratch
Vitality Egg Mash
Vitality Fine Chick Scratch
Vitality Growing Mash
Vitality Scratch Feed, No Grit
Vitality 24% Dairy Feed with Molasses
Will-Pay Dairy Ration

Wadsworth Feed Company, Warren, Ohio
Wadfeeco Dairy Ration
Wadsworth's Special Dairy Ration

Washburn Crosby Company, Minneapolis, Minn.
Gold Medal Corn and Oat Feed No. 2
Gold Medal Hominy Feed
North Star Scratch Feed—No Grit
Washburn's Gold Medal Chick Feed—No Grit
Washburn's Gold Medal Chick Starter (with Dried Buttermilk)
Washburn's Gold Medal Developing Feed—No Grit
Washburn's Gold Medal Fancy Mixed Feed
Washburn's Gold Medal Growing Mash (with Dried Buttermilk)
Washburn's Gold Medal Hard Wheat Bran and Wheat Screenings
Washburn's Gold Medal Hard Wheat Flour Middlings and Wheat Screenings

Washburn's Gold Medal Hard Wheat Standard Middlings and Wheat Screenings
Washburn's Gold Medal Pure Hard Wheat Adrian Red Dog
Washburn's Gold Medal Scratch Feed, No Grit
Washburn's Gold Medal Vitamin Dairy Ration, containing Wheat Germ (Embryo)
Washburn's Gold Medal Vitamin Dairy Ration (24% Protein)
Washburn's Gold Medal Vitamin Egg Mash, containing Wheat Germ (Embryo)

Wolverton Flour Mills Co., Limited, St. Marys, Ontario, Canada

Wolmacs Bran
Wolmacs Shorts

Worcester Rendering Co., Auburn, Mass.

P. W. Meat Scrap
P. W. Special Meat Scrap

Yantic Grain & Products Company, Norwich, Conn.

Abington Dairy Feed
Big (Y) Dairy Ration
Big (Y) Flour Middlings
Big (Y) Growing Feed
Big (Y) Laying Mash
Big (Y) Mixed Feed
Gingh'm Gal Scratch Feed
Perfection Dairy Feed
Uncas Dairy Feed
Uncas Scratch Feed
Uncas Stock Feed

Inspection.

This inspection covers the year 1928 and includes the period from September 1st to December 31st in 1927.

The Station inspector visited about 150 dealers in 100 towns in the State and collected 779 samples, which number includes all of the registered brands which were found on sale.

During the year 812 samples of commercial feeding stuffs and other fodder materials were analyzed. Of this number 716 were official inspection samples, 57 were silage and similar materials examined for the Storrs station, and the remaining 39 were submitted by individuals. Only those samples examined for official inspection purposes and those analyzed for individuals are included in this report.

Analyses of official samples are given in Table I and those of unofficial samples in Table II. Results, as soon as available, are reported to manufacturers, jobbers or dealers, and purchasers. In case of deficient brands second samples are drawn and analyzed if they can be obtained.

SUMMARY OF INSPECTION.

Feed	Samples examined	Samples deficient	Deficiencies in			Total deficiencies
			Protein	Fat	Fiber	
Cottonseed Meal	16	1	1	0	1	2
Linseed Meal	11	4	1	1	2	4
Wheat Bran	27	2	2	0	0	2
Wheat Middlings	33	1	1	0	0	1
Wheat Red Dog	10	1	1	0	1	2
Wheat Feed (Mixed Feed)	17	3	3	0	0	3
Corn Gluten Feed	8	0	0	0	0	0
Hominy Feed	16	2	0	0	2	2
Rye Products	2	0	0	0	0	0
Brewers' & Distillers' Grains	7	4	3	0	1	4
Dried Beet Pulp	2	1	1	0	0	1
Horse Feeds, etc	73	16	2	7	8	17
Dairy Feeds	161	59	19	48	8	75
Stock Feeds	25	5	0	3	2	5
Calf Feed, etc	14	3	0	3	0	3
Poultry Feeds	252	40	9	28	6	43
Beef Scrap, etc	42	14	12	3	0	15
Totals	716	156	55	93	31	179

In the tabulated summary of the inspection deficiencies of 0.75 per cent or less in protein and in fiber and 0.25 per cent or less in fat are not included. From this summary it appears that 22 per cent of the samples examined failed to meet their guaranties in one or more particulars. Of the 2,148 guaranties made, there being 3 for each sample, 179 or 8 per cent, were not met; in other words, 92 per cent of guaranties made were substantially equalled or exceeded. These figures are about the same as found for the past two years, except that this year the proportion of samples equalling guaranties is somewhat (about 5 per cent), less.

It is illegal in this State to attach tags by means of wire or other metallic device. Only two instances of violation of this provision were found.

Samples have been examined microscopically for foreign or deleterious substances and to check the ingredients found with those declared by statements on labels or in registrations as filed with the Station. No samples were found this year which contained weed seeds in conspicuous amounts and no instances of the substitution of inferior materials were detected. The checking of claimed ingredients is often complicated by revisions of formulas which may be filed by manufacturers subsequent to their original registrations. However, so far as could be determined ingredients as stated were in the main substantiated by our examinations.

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1928

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	OIL SEED PRODUCTS. *Cottonseed Meal.*		%	%	%	%	%	%	%	%	%
8711	*Atlas Standard.* E. T. Allen Co., Atlanta, Ga	*Hazardville:* A. D. Bridges' Sons	4.25	5.94	36.19	36.00	14.63	14.00	33.59	5.40	5.50
414	*Atlas Standard.* E. T. Allen Co., Atlanta, Ga	*Farmington:* Winchell Smith	4.08	6.52	36.00	36.00	14.30	14.00	32.20	6.90	5.50
7848	*Helmet.* Ashcraft-Wilkinson Co., Atlanta, Ga	*Guilford:* Fred C. Morse & Son	6.25	6.36	40.63	41.00	8.78	10.00	29.23	8.75	6.00
9786	*Owl 36%.* F. W. Brode Corp., Memphis, Tenn	*Plantsville:* C. A. Cowles	8.30	6.08	35.50	36.00	12.83	14.00	30.36	6.93	5.00
7815	*Owl 41%.* F. W. Brode Corp., Memphis, Tenn	*Simsbury:* Woods Chandler Co.	6.70	6.33	41.44	41.00	9.75	10.00	28.28	7.50	5.00
285	*Owl 41%.* F. W. Brode Corp., Memphis, Tenn	*Guilford:* Fred C. Morse & Son	6.43	7.25	42.69	41.00	8.40	10.00	27.87	7.36	5.00
7590	*Buckeye Prime 41%.* Buckeye Cotton Oil Co., Cincinnati, Ohio	*Bethel:* Morrison & Dunham	7.68	6.65	42.25	41.00	8.42	10.00	28.19	6.81	6.50
9923	*Eastern States 41%.* Eastern States Farmers' Exchange, Springfield, Mass	*New Milford:* W. E. Bostwick	7.55	6.51	40.63	41.00	10.43	10.00	28.48	6.40	6.00

8673	*Danish.* Humphreys-Godwin Co., Memphis, Tenn.....	*East Wallingford:* D. W. Ives..	3.25	5.43	36.38	36.00	12.63	15.00	35.41	6.90	5.00
8725	*Bull.* Humphreys-Godwin Co., Memphis, Tenn.....	*Plantsville:* C. A. Cowles.....	4.70	6.35	43.00	43.00	6.85	10.00	30.80	8.30	5.00
8794	*Dixie.* Humphreys-Godwin Co., Memphis, Tenn.....	*Thomaston:* Thomaston Supply Co.....	4.98	5.83	39.75	41.12	10.93	10.00	31.71	6.80	5.00
8277	*Larro.* Larrowe Milling Co., Detroit, Mich.....	*Branford:* S. V. Osborn, Est...	5.15	7.44	43.88	43.00	6.90	10.00	29.55	7.08	6.00
8552	*Lovit 41%.* L. B. Lovitt & Co., Memphis, Tenn.....	*Bristol:* Bristol Grain & Supply	4.28	7.17	43.13	41.00	7.10	10.00	31.07	7.25	6.00
238	*Lovit 36%.* L. B. Lovitt & Co., Memphis, Tenn.....	*Torrington:* Litchfield County Co-op.....	6.60	6.07	35.63	36.00	13.15	15.00	32.35	6.20	5.00
400	*Durham 43%.* Memphis Cottonseed Products Co., Memphis, Tenn.....	*Farmington:* Winchell Smith..	6.95	7.40	42.00	43.00	6.83	10.00	29.29	7.53	6.00
7926	National Cottonseed Products Corp., Memphis, Tenn.....	*Devon:* Devon Coal & Ice Co..	....	....	41.06	41.00	9.03	....	....	....	....
	Linseed Meal.										
8626	*Alinco Old Process.* American Linseed Co., Buffalo, N. Y..	*Guilford:* Fred H. Rolf.....	4.45	4.91	34.00	34.00	8.55	9.00	41.84	6.25	5.00
8721	*Old Process.* Archer-Daniels-Midland Co., Minneapolis, Minn.....	*Middletown:* Meech & Stoddard, Inc.....	6.45	5.30	35.38	34.00	8.20	9.00	39.77	4.90	5.00
9989	*Old Process.* Archer-Daniels-Midland Co., Minneapolis, Minn.....	*Southbury:* H. R. Stone.....	9.20	5.43	35.00	32.00	7.83	9.00	37.38	5.16	5.00
7950	*Maple Leaf Oilcake Meal.* Canada Linseed Oil Meal Co., Montreal, Canada.....	*Seymour:* Seymour Grain and Coal Co.....	10.00	5.50	34.56	34.00	7.70	7.00	37.09	5.15	5.00
8627	*Maple Leaf 35%.* Canada Linseed Oil Mills, Montreal, Canada.....	*Seymour:* Seymour Grain and Coal Co.....	4.85	5.23	35.88	35.00	7.80	7.00	40.84	5.40	5.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1928—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	OIL SEED PRODUCTS—*Concluded.*		%	%	%	%	%	%	%	%	%
	Linseed Meal—Concluded.										
355	*Maple Leaf 35%.* Canada Linseed Oil Mills, Montreal, Canada	*Simsbury:* Woods-Chandler Co.	9.40	5.11	35.25	35.00	7.98	7.00	36.58	5.68	5.00
8556	*Kellogg's Pure Old Process.* Spencer Kellogg & Sons, Buffalo, N. Y.	*Plainville:* W. S. Eaton	6.70	5.03	35.13	34.00	7.73	10.00	39.06	6.35	5.00
7841	Mann Bros. Co., Buffalo, N. Y.	*Middletown:* Meech & Stoddard, Inc.	10.61	5.30	34.69	32.00	7.58	10.00	35.36	6.46	6.00
8700	*33% Old Process.* Mann Bros. Co., Buffalo, N. Y.	*Middlefield:* Middlefield Grain & Coal	7.23	6.66	33.69	33.00	8.03	10.00	38.74	5.65	6.00
9974	*33% Old Process.* Mann Bros. Co., Buffalo, N. Y.	*Seymour:* Seymour Grain & Coal Co.	11.22	5.01	32.00	33.00	8.20	10.00	36.09	7.48	6.00
9972	*Red Wing.* Pittsburg Plate Glass Co., Newark, N. J.	*Seymour:* Seymour Grain & Coal Co.	10.28	5.94	33.81	32.00	7.98	9.00	36.35	5.64	5.00

	Wheat Products.										
	Wheat Bran.										
115	*Dandy.* Copeland Flour Mills, Midland, Canada	*Shelton:* Wolf Savitsky	11.33	5.72	13.50	15.00	10.25	11.50	53.88	5.32	3.50
9954	Dominion Flour Mills, Montreal, Canada	*Derby:* Peterson-Hendee Co.	11.15	5.60	13.88	15.00	10.05	11.50	53.85	5.47	3.50
9994	The Fairchild Milling Co., Cleveland, Ohio	*Highwood:* T. C. Hadden & Co.	11.40	6.07	15.19	14.00	9.23	12.00	53.08	5.03	3.50
7799	*Choice.* Hecker-Jones-Jewell Milling Co., Buffalo, N. Y.	*West Cheshire:* Cheshire Grain & Coal Co.	10.87	6.31	15.50	13.50	10.00	14.00	53.61	3.71	3.50
8321	*Choice.* Hecker-Jones-Jewell Milling Co., N. Y.	*Middlefield:* Middlefield Grain & Coal Co.	5.60	5.89	14.00	14.00	10.00	14.00	59.66	4.85	3.50
9984	*Ben Hur.* Hennepin Mill Co., Minneapolis, Minn	*Southbury:* H. R. Stone	12.10	5.46	13.88	14.00	9.75	12.00	53.50	5.31	4.00
7849	*Black Hawk.* International Milling Co., Minneapolis, Minn	*Guilford:* Fred C. Morse & Son	10.36	6.69	15.38	15.00	10.03	12.00	52.69	4.85	3.20
236	*Big Flake.* Kansas Flour Mills Corp., Kansas City, Mo.	*Thompsonville:* Geo. S. Phelps & Co.	10.88	7.33	15.94	15.00	9.40	11.00	52.30	4.15	3.50
113	*Lakewoods.* Chas. M. Cox, Boston, Mass	*Plantsville:* C. A. Cowles	11.40	6.05	12.75	15.00	10.90	11.00	53.45	5.45	3.50
47	Larrabee Flour Mills Co., Kansas City, Mo	*Canton:* Canton Creamery	10.40	7.39	15.63	15.00	10.35	10.00	51.83	4.40	3.50
8728	Minneapolis Milling Co., Minneapolis, Minn	*Ansonia:* Ansonia Flour & Feed Co.	5.65	6.18	15.31	14.50	11.30	12.00	56.13	5.43	5.00
9931	*Moon's.* Geo. Q. Moon & Co., Binghamton, N. Y.	*Stratford:* Z. C. Ingersol	10.68	4.75	13.00	13.00	8.38	10.00	57.78	5.41	3.00
8274	*Pure (extra broad).* National Milling Co., Toledo, Ohio	*Granby.* E. H. Rollins	7.01	6.53	15.69	14.00	9.15	10.00	57.12	4.50	3.00
382	*Pure.* National Milling Co., Toledo, Ohio	*Lebanon:* Berkman Grain Co.	10.65	7.07	17.00	14.00	8.60	10.00	52.30	4.38	3.00
250	*Pure.* Nebraska Consolidated Mills Co., Omaha, Neb.	*East Winsted:* Leonard Grain Co.	10.13	6.41	16.13	15.50	8.93	11.00	54.07	4.33	3.50

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1928—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	WHEAT PRODUCTS—*Continued.*		%	%	%	%	%	%	%	%	%
	Wheat Bran—Concluded.										
8805	*Niagara Choice.* Niagara Falls Milling Co., Niagara Falls, N. Y.	*Derby:* Peterson-Hendee Co.	8.40	5.13	14.88	14.00	8.85	11.00	57.29	5.45	3.50
8659	*Pure.* Northwestern Consolidated Milling Co., Minneapolis, Minn.	*Wallingford:* A. E. Hall	9.80	6.16	16.69	13.50	8.53	12.00	53.74	5.08	4.00
8204	*Ogilvie.* Ogilvie Flour Mills Co., Montreal, Canada	*Hamden:* I. W. Beers	8.75	5.82	15.00	15.00	9.60	11.50	55.25	5.58	3.50
9	*Pillsbury's.* Pillsbury's Flour Mills, Minneapolis, Minn.	*Plainville:* W. S. Easton	10.50	7.33	14.94	14.00	6.85	12.00	55.39	4.99	4.00
8771	*Bell Cow.* Quaker Oats Co., Chicago, Ill.	*Waterbury:* Spencer Grain Co.	10.05	5.39	15.13	15.00	9.53	10.00	54.42	5.48	3.50
7923	*Superior.* Robin Hood Mills, Calgary, Canada	*Shelton:* Wolf Savitsky	10.11	5.04	16.94	15.00	10.12	11.50	52.14	5.65	3.50
8770	*Occident.* Russell Miller Milling Co., Minneapolis, Minn.	*Waterbury:* Spencer Grain Co.	10.55	6.09	15.81	14.00	8.78	11.50	52.59	6.18	4.00

118	*Red Turkey.* Southwestern Milling Co., Kansas City, Mo	*Seymour:* Seymour Grain & Coal	10.15	7.15	15.94	14.50	9.65	11.00	52.93	4.18	3.50
142	St. Lawrence Milling Co., Montreal, Canada	*Bridgeport:* Samp Mortar Mills	10.00	5.22	14.50	15.00	9.45	11.50	56.03	4.80	3.50
102	Standard Milling Co., Toronto, Canada	*Farmington:* Winchell Smith	12.03	5.46	14.25	15.00	9.75	11.50	53.08	5.43	3.50
9991	*Tioga.* Tioga Empire Feed Mills, Waverly, N. Y.	*Plantsville:* C. A. Cowles	11.33	6.24	12.88	13.00	7.85	10.00	57.61	4.09	3.00
8312	*Gold Medal.* Washburn-Crosby Co., Minneapolis, Minn	*Branford:* S. V. Osborn, Est	6.95	5.66	14.38	14.00	9.63	12.00	58.03	5.35	4.00
	Wheat Middlings, etc.										
114	*Dandy Shorts.* Copeland Flour Mills, Midland, Canada	*Shelton:* Wolf Savitsky	11.18	4.16	16.50	16.00	6.58	8.00	56.04	5.54	5.00
8315	*Wheat Shorts.* Dominion Flour Mills, Montreal, Canada	*Branford:* S. V. Osborn, Est	5.95	4.29	16.63	16.00	7.34	8.00	59.69	6.10	5.00
7818	*Elmore Snow Middlings.* Elmore Milling Co., Oneonta, N. Y.	*Thompsonville:* Geo. S. Phelps & Co	10.90	3.88	16.38	16.00	5.73	7.00	58.46	4.65	4.25
8594	*Eshelman's Wheat Flour Middlings.* John W. Eshelman & Son, Lancaster, Pa	*Devon:* Devon Coal & Ice Co	5.70	3.40	15.81	16.00	5.43	6.00	65.11	4.55	4.00
8183	*Standard Middlings.* The Fairchild Milling Co., Cleveland, Ohio	*Highwood:* T. C. Hadden & Co.	9.40	4.54	16.50	15.00	6.65	9.00	57.81	5.10	4.00
8727	*H. Wheat Middlings.* Hecker-Jones-Jewell Milling Co., New York City	*Southington:* Southington Lumber Co	7.80	4.64	16.56	15.00	7.93	9.50	57.64	5.43	5.00
8022	*Ben Hur Hard Wheat Flour.* Hennepin Mill Co., Minneapolis, Minn	*Thomaston:* Thomaston Supply Co	10.21	4.01	15.81	16.00	4.10	6.00	60.52	5.35	4.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1928—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	WHEAT PRODUCTS—*Continued.* *Wheat Middlings, etc.—Cont.*		%	%	%	%	%	%	%	%	%
8024	*Ben Hur Hard Wheat Standard.* Hennepin Mill Co., Minneapolis, Minn	*Thomaston:* Thomaston Supply Co	10.25	4.60	16.25	15.00	7.95	9.50	55.42	5.53	4.00
8475	*Ben Hur Middlings.* Hennepin Mill Co., Minneapolis, Minn.	*West Cheshire:* Cheshire Grain & Coal Co	6.43	4.49	16.63	15.00	7.71	9.50	58.84	5.90	4.00
8486	*Black Hawk Flour.* International Milling Co., Minneapolis, Minn	*Plantsville:* C. A. Cowles	9.40	2.44	16.13	15.00	2.73	4.50	65.10	4.20	3.50
9934	*Black Hawk Standard Middlings.* International Milling Co., Minneapolis, Minn	*Stratford:* Z. C. Ingersoll	10.91	4.73	16.31	15.00	7.28	8.50	55.45	5.32	4.50
155	*Standard Middlings.* King Midas Mill Co., Minneapolis, Minn	*Wallingford:* Laden Bros	10.68	4.53	16.00	15.00	7.20	9.50	55.84	5.75	4.00
7931	*Flour Middlings.* E. Manchester & Sons, Winsted	*Winsted:* E. Manchester & Sons	10.41	3.70	16.25	15.00	6.03	6.00	59.13	4.48	4.00
243	*Red Star Flour.* E. Manchester & Sons, Winsted	*Winsted:* E. Manchester & Sons	9.75	3.54	16.56	15.00	5.43	6.00	60.14	4.58	4.00

288	*Moon's Fresh Ground White.* Geo. Q. Moon & Co., Binghamton, N. Y.	*Norfolk:* Aug. P. Curtis	8.98	2.14	15.00	15.00	2.18	3.50	67.92	3.78	3.50
358	*Pure Flour.* Nebraska Consolidated Mills, Omaha, Neb.	*East Winsted:* Leonard Grain Co.	9.65	4.23	17.38	16.00	5.18	5.50	58.56	5.00	4.50
8495	*Palmo Midds.* Newsome Feed & Grain Co., Pittsburg, Pa.	*Plantsville:* Mehmel & Sarvi	6.45	4.90	15.63	16.00	5.83	9.00	56.49	10.70	7.00
8804	*Niagara Choice.* Niagara Falls Milling Co., Niagara Falls, N. Y.	*Derby:* Peterson-Hendee Co.	8.45	4.52	16.25	15.50	7.55	9.50	57.28	5.95	4.00
8641	*Flour.* Northwestern Consolidated Mill Co., Minneapolis, Minn	*No. Haven:* W. L. Thorpe	5.35	3.70	16.06	15.00	5.90	6.00	62.94	6.05	4.00
374	*Wheat Standard.* Northwestern Consolidated Milling Co., Co., Minneapolis, Minn	*Bloomfield:* Bloomfield Farmers' Exchange	9.55	4.78	16.69	15.00	8.08	9.50	55.25	5.65	4.00
8203	*Ogilvie's Wheat Shorts.* Ogilvie Flour Mills Co., Montreal, Canada	*Hamden:* I. W. Beers	8.25	5.11	15.75	16.00	7.45	8.00	57.71	5.73	5.00
9953	*Flour.* Park & Pollard Co., Buffalo, N. Y.	*Derby:* Peterson-Hendee Co.	11.46	3.25	16.00	16.00	4.83	6.00	60.22	4.24	4.00
8	*Pillsbury's Hard Wheat A.* Pillsbury Flour Mills, Minneapolis, Minn	*Plainville:* W. S. Eaton	10.90	3.81	17.75	16.00	4.50	6.00	58.06	4.98	4.00
10	*Pillsbury's Hard Wheat Standard B.* Pillsbury Flour Mills, Minneapolis, Minn	*Plainville:* W. S. Eaton	10.78	4.73	17.31	15.00	6.80	9.50	55.14	5.24	4.00
7801	*Superior Wheat Shorts.* Robin Hood Mills, Ltd., Calgary, Canada	*Plantsville:* C. A. Cowles	10.73	4.02	18.75	17.00	7.80	8.00	53.38	5.32	5.00
135	*Wirthmore Flour.* St. Albans Grain Co., St. Albans, Vt.	*Branford:* S. V. Osborn Est.	10.98	4.36	15.44	15.00	5.58	6.00	58.84	4.80	4.00
103	*Shorts.* Standard Milling Co., Toronto, Canada	*Bloomfield:* Bloomfield Farmers' Exchange	10.98	4.65	16.75	16.00	6.85	8.00	55.12	5.65	5.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1928—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	WHEAT PRODUCTS—*Coninued*		%	%	%	%	%	%	%	%	%
	Wheat Middlings, etc.—Concl.										
8790	*Pennant.* David Stott Flour Mills, Detroit, Mich.	*Waterbury:* Spencer Grain Co.	7.30	4.96	15.13	15.00	7.61	9.00	59.90	5.10	4.00
8197	*Syragold Flour.* Syracuse Milling Co., Syracuse, N. Y.	*Litchfield:* Wadhams Co.	6.20	3.86	17.13	15.00	5.88	6.00	62.05	4.88	4.00
411	*Syragold Flour.* Syracuse Milling Co., Syracuse, N. Y.	*Colchester:* P. Cutler Inc.	10.48	3.01	15.44	15.00	3.83	6.00	62.81	4.43	4.00
7952	*Angelus.* Thompson Milling Co., Lockport, N. Y.	*Waterbury:* Spencer Grain Co.	22.41	4.48	19.00	15.50	6.40	7.00	41.89	5.82	4.50
9999	*Gold Medal Standard.* Washburn-Crosby Co., Minneapolis, Minn.	*Plantsville:* C. A. Cowles.	10.98	4.73	16.81	15.00	7.08	9.50	55.45	4.95	4.00
315	*Big (Y) Flour Middlings.* Yantic Grain & Products Co., Norwich.	*Mystic:* Mystic Grain Co.	10.95	3.80	15.38	17.00	6.45	6.00	58.62	4.80	5.00
	Wheat Red Dog, etc.										
7943	*Wingold Diamond G.* Bay State Milling Co., Winona, Minn.	*Danbury:* F. C. Benjamin.	11.90	2.70	17.00	17.00	2.38	2.50	61.64	4.38	3.50

8275	*Eshelman's.* John W. Eshelman & Sons, Lancaster, Pa.	*Thompsonville:* Geo. S. Phelps & Co	7.48	2.92	16.50	16.00	3.35	4.00	65.75	4.00	4.00
8729	The Fairfax Milling Co., Fairfax, Minn	*New Haven:* Moran-Patton Co.	5.68	2.60	16.75	14.50	2.60	4.00	68.99	3.38	3.00
8766	*Red Wing Special.* The Fairfax Milling Co., Red Wing, Minn	*Plantsville:* C. A. Cowles	9.80	2.63	16.50	14.50	2.75	4.00	64.54	3.78	3.00
7850	Hecker - Jones - Jewell Milling Co., New York City	*Higganum:* F. A. Petrofsky	10.30	3.18	18.44	15.75	3.30	4.00	59.23	5.55	4.50
8490	*Black Hawk Wheat Low Grade Flour.* International Milling Co., Minneapolis, Minn	*Plantsville:* C. A. Cowles	10.70	1.13	14.50	14.00	0.83	1.50	70.26	2.58	1.80
8013	*Modoc Low Grade Flour.* H. H. King Flour Mills, Minneapolis, Minn	*Long Hill:* Long Hill Feed Store	10.06	3.48	19.44	16.00	4.15	4.00	57.82	5.05	4.00
7937	Maritime Milling Co., Buffalo, N. Y	*New Milford:* Geo. E. Ackley & Co	10.85	3.38	16.75	16.00	3.65	4.00	61.17	4.20	4.00
138	*Wirthmore.* St. Albans Grain Co., St. Albans, Vt	*New Haven:* R. G. Davis & Sons	11.03	2.21	15.06	16.00	2.28	4.00	66.14	3.28	4.00
145	*Washburn's Gold Medal Adrian.* Washburn-Crosby Co., Minneapolis, Minn	*Manchester:* Manchester Grain & Coal Co	10.60	2.20	15.50	16.00	1.90	4.00	66.28	3.52	3.50
	Wheat Feed (Mixed Feed).										
263	*Crosby's.* Crosby Milling Co., Brattleboro, Vt	*Kent:* Kent Grain & Coal Co.	10.49	5.16	15.00	15.00	6.98	9.50	57.82	4.55	4.50
8023	*Ben Hur Fancy Mixed.* Hennepin Milling Co., Minneapolis, Minn	*Thomaston:* Thomaston Supply Co	10.87	4.18	14.81	16.00	6.13	7.50	59.56	4.45	4.00
8676	*Gold Mine.* H. H. King Flour Mills, Minneapolis, Minn	*Kensington:* S. F. Labieniec	5.35	5.03	16.00	15.00	8.40	9.50	59.42	5.80	4.50
242	*Red Star.* E. Manchester & Sons, Winsted	*Winsted:* E. Manchester & Sons	9.78	4.71	16.31	15.00	6.78	7.50	57.74	4.68	4.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1928—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	WHEAT PRODUCTS—*Continued.* *Wheat Feed (Mixed Feed)*—*Concluded.*		%	%	%	%	%	%	%	%	%
295	*Bull.* Maritime Milling Co., Buffalo, N. Y.	*New Milford:* Geo. E. Ackley & Co	9.85	4.27	14.25	15.00	7.43	8.00	59.75	4.45	4.00
119	*Red Wing.* Meech & Stoddard, Inc., Middletown, Conn.	*East Hartford:* Meech Grain Co.	10.40	4.30	15.13	15.00	6.55	10.00	58.92	4.70	4.50
120	*Moon's.* Geo. Q. Moon & Co., Binghamton, N. Y.	*Manchester:* I. P. Campbell	10.38	5.82	15.50	14.00	8.03	10.00	55.42	4.85	4.00
50	*Osota.* National Milling Co., Toledo, Ohio	*Simsbury:* Woods-Chandler Co	10.15	5.24	16.75	15.00	7.65	10.00	55.75	4.46	4.50
8640	*X X X Comet.* North Western Consolidated Milling Co., Minneapolis, Minn	*No. Haven:* W. L. Thorpe	5.30	3.03	18.13	16.00	2.58	4.00	65.06	5.90	4.00
402	Northwestern Consolidated Milling Co., Minneapolis, Minn	*Farmington:* Winchell Smith	10.28	5.41	16.38	15.00	7.80	8.50	54.68	5.45	4.00
8795	*Pillsbury's X X Daisy.* Pillsbury Flour Mills, Minneapolis, Minn	*Thomaston:* Thomaston Supply Co	8.10	2.28	17.50	16.00	1.43	4.00	66.01	4.68	4.00

183	*Pillsbury's Fancy Mixed.* Pillsbury Flour Mills, Minneapolis, Minn	*Danbury:* C. S. Barnum & Son.	10.23	3.75	17.50	15.00	4.10	8.50	59.17	5.25	4.00
8563	*Occident.* Russell Miller Milling Co., Minneapolis, Minn	*Ansonia:* Ansonia Flour & Feed Co	7.68	4.43	16.06	15.00	7.10	9.50	58.95	5.78	4.50
136	*Wirthmore.* St. Albans Grain Co., St. Albans, Vt	*Branford:* S. V. Osborn Est	10.83	4.46	14.13	15.00	7.18	8.00	58.82	4.58	4.50
260	*Washburn's Gold Medal.* Washburn Crosby Co., Minneapolis, Minn	*Torrington:* D. L. Talcott	10.00	4.10	14.63	16.00	6.63	7.50	60.04	4.60	4.00
442	*Washburn's Gold Medal.* Washburn Crosby Co., Minneapolis, Minn	*New Milford:* Geo. T. Soule	11.00	4.14	16.00	16.00	5.45	7.50	58.88	4.53	4.00
362	*Big (Y).* Yantic Grain & Products Co., Norwich	*Abington:* Weeks Bros	10.25	4.39	15.31	16.00	7.58	8.00	57.24	5.23	4.50
	MAIZE PRODUCTS.										
	Corn Gluten Feed.										
8709	American Maize Products Co., New York City	*Middletown:* Meech & Stoddard Inc	7.20	4.73	28.06	23.00	7.63	8.50	50.03	2.35	2.00
8580	*Amco.* American Milling Co., Peoria, Ill	*Newington:* Thos. Holt	6.85	1.77	10.00	9.00	3.43	5.00	73.00	4.95	4.00
8566	*Clinton.* Clinton Corn Syrup Refining Co., Clinton, Iowa	*Seymour:* Seymour Grain & Coal Co	6.63	5.83	27.06	23.00	6.83	8.50	50.65	3.00	2.00
8184	*Buffalo.* Corn Products Refining Co., New York City	*Highwood:* T. C. Hadden & Co.	7.50	6.41	24.25	23.00	7.55	8.50	52.01	2.28	2.00
9985	*Diamond.* Corn Products Refining Co., New York City	*Southbury:* H. R. Stone	8.35	1.25	39.56	40.00	2.88	4.00	44.21	3.75	1.00
157	*Keokuk.* J. C. Hubinger Bros. Co., Keokuk, Iowa	*Norwalk:* Frank Libner & Sons	9.58	4.00	28.25	23.00	7.18	8.50	48.86	2.13	2.00
8476	*Staley's.* A. E. Staley Mfg. Co., Decatur, Ill	*West Cheshire:* Cheshire Grain & Coal Co	6.45	5.96	25.25	23.00	5.50	8.00	54.09	2.75	1.00
8677	*Union.* Union Sales Corp., Columbus, Ind	*Kensington:* S. F. Labieniec	7.15	7.52	26.81	23.00	7.30	8.00	49.24	1.98	1.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1928—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	MAIZE PRODUCTS—*Continued.*		%	%	%	%	%	%	%	%	%
	Hominy Feed.										
8644	*Advance.* Advance Milling Co., Chicago, Ill.	*North Haven:* W. L. Thorpe..	5.40	2.50	10.75	10.00	3.95	5.00	70.40	7.00	7.00
8559	*Homco.* Decatur Milling Co., Decatur, Ill.	*East Haven:* A. W. Forbes....	6.18	2.68	10.75	10.00	4.60	6.00	68.54	7.25	7.00
8767	*White.* Kellogg Company, Battle Creek, Mich.	*Southington:* Southington Lumber Co.	8.58	2.25	10.88	10.00	3.65	5.00	67.94	6.70	6.00
356	*Badger White.* Chas. A. Krause Milling Co., Milwaukee, Wis.	*Thomaston:* I. Levy	9.58	2.70	12.38	10.00	4.95	5.00	63.76	6.63	6.00
352	*Sonny South.* Louisville Milling Co., Louisville, Ky.	*Manchester:* Little & McKinney	8.80	8.27	11.56	10.00	5.48	6.00	60.06	5.83	7.00
49	*Steam Cooked.* Miner-Hillard Milling Co., Wilkes-Barre, Pa.	*Bloomfield:* Bloomfield Farmers' Exchange	10.33	2.22	10.63	10.00	3.25	5.00	69.64	3.93	4.00
9933	*Moon's.* Geo. Q. Moon & Co., Binghamton, N. Y.	*Stratford:* Z. C. Ingersoll	8.41	2.17	10.94	10.00	5.98	6.00	66.10	6.40	5.00
8792	*Poco.* Mt. Vernon Milling Co., Mt. Vernon, Ind.	*Thomaston:* Thomaston Supply Co.	7.18	3.54	12.00	10.00	4.65	6.00	65.13	7.50	7.00

8672	Patent Cereal Co., Geneva, N. Y.	*East Wallingford:* D. W. Ives..	5.25	2.51	10.88	10.00	3.83	5.00	73.43	4.10	5.00
8492	*Burts.* Postum Company, Inc., Battle Creek, Mich.	*Plantsville:* Mehmel & Sarvi..	10.65	1.82	10.00	10.00	2.73	5.00	65.10	9.70	6.00
8629	*Pratt's White.* Pratt Food Co., Buffalo, N. Y.	*Norwalk:* Frank Libner & Son	5.60	2.65	11.25	10.00	4.23	6.00	71.12	5.15	4.00
7792	*White.* Quaker Oats Co., Chicago, Ill.	*Highwood:* T. C. Hadden & Co.	11.16	1.86	9.50	10.50	4.69	6.00	67.73	5.06	5.00
8674	Quaker Oats Co., Chicago, Ill.	*Wallingford:* Laden Bros.	6.30	2.11	10.56	10.00	4.18	8.00	71.70	5.15	5.00
148	*Yellow.* Quaker Oats Co., Chicago, Ill.	*Long Hill:* Long Hill Feed Store	10.55	2.38	11.25	10.50	3.88	6.00	67.59	4.35	5.00
188	*White.* Quaker Oats Co., Chicago, Ill.	*Danbury:* C. S. Barnum & Son	8.85	2.15	10.00	10.50	5.18	6.00	68.42	5.40	5.00
8581	*Paragon.* St. Albans Grain Co., St. Albans, Vt.	*Newington:* Thos. Holt	6.20	3.25	10.63	10.00	4.48	7.00	67.99	7.45	6.00
	RYE PRODUCTS.										
8661	Miner-Hillard Milling Co., Wilkes-Barre, Pa.	*Wallingford:* A. E. Hall	7.90	3.53	15.63	12.00	4.20	5.00	65.31	3.43	2.50
8283	Upper Hudson Rye Flour Mills, Troy, N Y.	*Norwich:* Yantic Grain & Products Co.	7.88	3.62	14.88	13.50	4.33	6.00	66.29	3.00	3.00
	BREWERS' AND DISTILLERS' GRAINS.										
7917	*Dewey's Distillers Dried Grains.* Dewey Bros. Co., Blanchester, Ohio	*Norwich:* Yantic Grain Co.	7.70	4.70	28.44	30.00	9.40	13.00	39.36	10.40	10.00
8109	*Dewey's Distillers Dried Grains.* Dewey Bros., Blanchester, Ohio	*Norwich:* Yantic Grain & Products Co.	7.48	4.70	28.50	30.00	8.63	13.00	40.49	10.20	10.00
7925	*Bull Brand Dried Brewers Grains.* Farmers' Feed Co., Buffalo, N. Y.	*Long Hill:* Long Hill Feed Store	5.95	3.75	23.44	22.00	16.43	15.00	43.38	7.05	6.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1928—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	BREWERS' AND DISTILLERS' GRAINS—*Continued.*										
106	*Bull Brand Dried Grains.* Farmers' Feed Co., York City	*New Haven:* R. G. Davis & Sons	6.00	3.50	24.38	22.00	15.35	15.00	43.92	6.85	6.00
9976	*Alco Dried Brewers' Grains.* C. J. Martenis Grain Co., New York City	*Seymour:* Seymour Grain & Coal Co	8.20	3.86	21.06	21.00	13.85	20.00	46.59	6.44	6.00
146	*Alco Dried Distillers' Grains.* C. J. Martenis Grain Co., New York City	*Guilford:* Fred C. Morse	7.50	1.89	27.75	30.00	10.98	15.00	43.33	8.55	8.00
216	*Brewers' Dried Grains.* St. Albans Grain Co., St. Albans, Vt	*Danbury:* F. C. Benjamin	8.78	3.95	20.81	21.00	13.38	15.00	46.80	6.28	5.00
	DRIED BEET PULP.										
8191	The Larrowe Milling Co., Detroit, Mich	*Hamden:* I. W. Beers	5.51	3.21	9.38	8.00	18.33	22.00	62.82	0.75	0.50
9961	*Molasses Beet Pulp.* The Larrowe Milling Co., Detroit, Mich	*Ansonia:* Ansonia Flour & Feed Co	11.08	4.98	7.06	8.00	13.83	20.00	62.49	0.56	0.50

	PROPRIETARY MIXED FEEDS. *Horse Feed, etc.*										
7902	*Amco.* American Milling Co., Peoria, Ill.	*Middletown:* Charles Dragoo..	8.70	10.80	13.19	10.00	17.13	21.00	49.33	0.85	0.50
7933	*Amco.* American Milling Co., Peoria, Ill.	*Falls Village:* H. E. Dean....	10.48	3.31	9.44	9.00	7.46	9.00	65.71	3.60	2.50
8577	*Amco.* American Milling Co., Peoria, Ill.	*Newington:* Thos. Holt.....	7.23	3.15	9.38	9.00	6.83	9.00	68.53	4.88	3.50
8579	*Amco June Pasture Alfalfa and Molasses.* American Milling Co., Peoria, Ill.	*Newington:* Thos.. Holt.....	6.85	10.41	12.38	10.00	18.53	21.00	51.15	0.68	0.50
379	*Amco Provender ½ and ½.* American Milling Co., Peoria, Ill.	*Gildersleeve:* John H. Fay.....	10.48	2.50	11.31	10.00	6.03	10.00	65.35	4.33	4.00
7912	*Wonder.* Arcady Farms Milling Co., Chicago, Ill.	*Putnam:* Dayville Grain Co..	6.90	4.58	10.00	10.50	9.08	10.00	65.61	3.83	3.00
8279	*Chariot.* Beacon Milling Co., Cayuga, N. Y.	*Danbury:* C. S. Barnum & Son	5.50	5.16	10.00	8.00	7.59	10.00	69.35	2.40	2.00
8280	*Beacon Hog Feed.* Beacon Milling Co., Cayuga, N. Y.	*Bethlehem:* A. T. Minor.....	6.95	7.59	19.81	18.00	6.50	7.00	53.55	5.60	5.00
149	*Beacon.* Beacon Milling Co., Cayuga, N. Y.	*Danbury:* C. S. Barnum & Son	12.10	4.18	11.06	9.00	7.20	11.00	62.26	3.20	2.50
7853	C. W. Campbell Co., Westerly R. I.	*Westerly:* C. W. Campbell Co..	12.01	6.10	11.38	....	6.68	....	59.78	4.05	....
310	*Provender.* C. W. Campbell, Stonington, Conn.	*Mystic:* C. W. Campbell Co..	10.28	2.82	10.63	10.00	7.25	10.00	63.74	5.28	4.00
311	C. W. Campbell Co., Stonington, Conn.	*Groton:* C. W. Campbell Co...	10.98	4.14	10.13	10.00	9.05	12.00	62.50	3.20	4.00
36	*Ajax.* Chapin & Co., Chicago, Ill.	*Collinsville:* Rourke-Robotham Co.	9.12	6.08	11.38	9.00	10.23	12.00	59.70	3.49	3.00
7920	*Co-Pro-Co.* Corn Products Refining Co., New York City..	*Westerly:* C. W. Campbell Co..	5.88	5.79	10.06	9.00	13.15	12.00	61.67	3.45	2.50
9924	*Davis.* R. G. Davis & Sons, New Haven, Conn.	*Milford:* Milford Grain Co...	10.51	4.02	9.63	9.00	7.65	10.00	64.71	3.48	3.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1928—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*		%	%	%	%	%	%	%	%	%
	Horse Feed, etc.—Continued.										
9962	*Davis No. 1 Provender.* R. G. Davis & Sons, New Haven, Conn	*Ansonia:* Ansonia Flour & Feed	11.85	2.86	10.00	10.00	8.18	8.00	64.23	2.88	3.50
312	*Davis No. 1 Provender.* R. G. Davis & Sons, New Haven, Conn	*New Haven:* R. G. Davis & Sons	10.48	3.26	10.56	10.00	7.83	8.00	63.87	4.00	3.50
7619	*Alfalfa Meal, Triple XXX.* Denver Alfalfa Milling Co., Lamar, Colorado	*New Haven:* R. G. Davis & Sons	....	9.86	13.63	13.00	....	....	....	....	....
9927	*Alfalfa Meal.* Denver Alfalfa Milling Co., Lamar, Colorado	*Devon:* Devon Coal & Ice Co..	9.44	9.03	14.50	13.00	30.53	33.00	34.54	1.96	1.00
7618	*Alfalfa Leaf Meal.* Denver Alfalfa Milling Co., Lamar, Colorado	*New Haven:* R. G. Davis & Sons	....	14.35	19.38	20.00	....	....	....	....	....

9928	*Alfalfa Leaf Meal (Leafalfa Brand).* Denver Alfalfa Milling and Products Co., Lamar, Colorado	*Devon:* Devon Coal & Ice Co.	9.90	12.21	21.25	20.00	14.03	18.00	39.53	3.08	2.50
8645	*Eastern States Open Formula.* Eastern States Farmers' Exchange, Springfield, Mass.	*North Haven:* Ridgewood Farm	7.40	3.94	11.00	11.00	5.90	7.00	67.37	4.39	3.50
159	*Elmore, with Molasses.* Elmore Milling Co., Oneonta, N. Y.	*Thomaston:* Thomaston Supply Co.	11.80	3.33	10.50	9.00	6.73	11.00	63.61	4.03	2.50
8273	*Eshelman's Red Rose 85.* John W. Eshelman & Sons, Lancaster, Pa.	*Hamden:* I. W. Beers	6.41	3.38	9.06	9.00	5.43	10.00	72.37	3.35	3.00
218	*Liberty.* John W. Eshelman & Sons, Lancaster, Pa.	*Southport:* C. Buckingham & Co.	11.63	7.45	9.06	7.00	9.60	10.00	59.76	2.50	2.00
219	*Lancaster 60.* John W. Eshelman & Sons, Lancaster, Pa.	*So. Norwalk:* Roodner Feed Co.	11.70	4.37	9.81	9.00	8.28	10.00	62.41	3.43	2.50
7948	*Flory's.* Flory Milling Co., Bangor, Pa.	*Long Hill:* Long Hill Feed Store	8.01	4.09	9.13	9.00	9.30	10.00	65.82	3.65	2.50
107	*Vio.* Flory Milling Co., Bangor, Pa.	*Long Hill:* Long Hill Feed Store	11.43	5.37	6.88	6.00	13.55	12.00	60.77	2.00	2.00
7800	*Bronco.* Grain Belt Mills Co., St. Joseph, Mo.	*Plantsville:* Mehmel & Sarvi.	10.45	6.58	10.94	9.00	13.33	15.00	57.10	1.60	2.00
111[1]	*Bronco.* Grain Belt Mills Co., So. St. Joseph, Mo.	*Westville:* R. G. Davis & Sons.	8.00	8.36	11.13	9.00	12.83	15.00	57.80	1.88	2.00
158[1]	*Hunter.* Grain Belt Mills Co, St. Louis, Mo.	*East Hartford:* Meech Grain Co.	11.25	6.59	9.75	9.00	8.50	14.00	61.88	2.03	2.00
8272	*Kingfalfa.* Hales & Hunter Co., Chicago, Ill.	*Highwood:* T. C. Hadden & Co.	5.04	5.54	9.25	9.00	10.93	15.00	66.96	2.28	2.00
112	*College.* Hales & Hunter Co., Chicago, Ill.	*Highwood:* T. C. Hadden & Co.	6.88	4.99	10.63	9.00	9.80	10.00	64.82	2.88	2.50
117	*Pioneer Hog Feed.* Hales & Hunter Co., Chicago, Ill.	*Highwood:* T. C. Hadden & Co.	8.78	8.52	21.06	16.00	6.70	9.00	50.66	4.28	4.00

[1] Wire tags illegal.

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1928—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*		%	%	%	%	%	%	%	%	%
	Horse Feed, etc.—Continued.										
130	*Re-Ground Oat Feed.* Hecker-H. O. Company, Buffalo, N. Y.	*Middletown:* Meech & Stoddard Inc.	6.58	6.50	7.38	5.00	24.45	28.00	52.36	2.73	2.00
8707	*Imperial Steam Cooked.* Imperial Grain & Mill Co., Toledo, Ohio	*Middletown:* Meech & Stoddard Inc.	10.05	2.08	9.81	9.50	4.90	4.60	68.81	4.35	4.00
156	*Badger.* Chas. A. Krause Milling Co., Milwaukee, Wis.	*Thomaston:* I. Levy	12.33	2.90	10.50	8.00	5.13	12.00	66.16	2.98	1.00
412	*Larro Hog Feed.* Larrowe Milling Co., Detroit, Mich.	*Collinsville:* Lawton-Miner Co.	8.43	6.24	19.50	18.00	9.05	10.00	51.18	5.60	5.00
440	*Bull Brand with Molasses.* Maritime Milling Co., Buffalo, N. Y.	*New Milford:* Geo. E. Ackley Co.	9.95	3.37	9.63	8.00	8.75	10.00	64.57	3.73	2.00
8803	*Red Wing Molasses.* Meech & Stoddard, Inc., Middletown, Conn.	*Middlefield:* Middlefield Grain & Coal	8.65	3.28	9.19	9.00	6.63	10.00	68.32	3.93	3.00

318	*"1795" Steam Cooked Corn and Oats.* Miner-Hillard Milling Co., Wilkes-Barre, Pa.....	*Westerly:* C. W. Campbell Co.	8.75	2.65	10.75	9.50	6.20	5.00	67.47	4.18	4.00
8319	*Old Mill Provender.* Fred C. Morse, Guilford, Conn	*Guilford:* Fred C. Morse.....	6.65	2.51	10.81	10.00	5.50	7.00	69.08	5.45	4.00
9922	Fred C. Morse, Guilford, Conn.	*Guilford:* Fred C. Morse.....	12.52	3.97	11.69	....	6.33	....	61.37	4.12	....
7852	*Domino Pep-O-Lene.* Nowak Milling Corp., Hammond, Ind.....	*Higganum:* F. A. Petrofsky...	12.20	2.98	9.00	8.00	7.68	10.00	64.34	3.80	2.00
52	*Domino Vim-O-Lene.* Nowak Milling Corp., Hammond, Ind.....	*Bloomfield:* Bloomfield Farmers' Exchange.....	10.55	3.69	9.88	8.00	7.18	9.00	64.58	4.12	2.00
7845	*Osborn Provender.* S. V. Osborn Est., Branford, Conn.....	*Branford:* S. V. Osborn Est...	11.05	2.45	11.31	10.00	5.75	8.00	65.39	4.05	4.00
7797	*Belmont.* Park & Pollard Co., Buffalo, N. Y.....	*West Cheshire:* Cheshire Grain & Coal.....	10.15	4.24	10.13	10.00	8.60	12.00	62.75	4.13	2.00
7922	*Corn & Oats ½ and ½.* Park & Pollard Co., Buffalo, N. Y..	*Shelton:* Shelton Feed Co.....	10.38	2.70	10.25	10.00	8.23	8.00	63.24	5.20	1.50
8479	*Arlington.* Park & Pollard Co., Buffalo, N. Y.....	*Plainville:* F. B. Newton.....	6.13	3.62	9.88	9.00	9.14	11.00	66.68	4.55	2.50
181	*Chelsea.* Park & Pollard Co., Buffalo, N. Y.....	*Waterbury:* Spencer Grain Co.	8.65	7.01	9.94	8.00	14.45	12.00	57.92	2.03	2.00
8710	*Alfalfa Leaf Meal.* Pecos Valley Alfalfa Mill Co., Hagerman, New Mexico.....	*West Cheshire:* Cheshire Grain & Coal.....	4.70	10.30	17.25	17.00	25.05	23.00	40.65	2.05	1.50
320	*Alfalfa Leaf Meal.* Pecos Valley Alfalfa Mill Co., Hagerman, New Mexico.....	*Botsford:* G. T. Rasmussen..	8.23	15.59	17.81	17.00	21.45	23.00	34.37	2.55	1.50
7589	*Iroquois Chop Feed.* Pratt Food Co., Buffalo, N. Y....	*Danbury:* C. S. Barnum & Son	11.61	7.00	9.38	8.00	10.06	12.00	58.95	3.00	4.00
185	*Utility.* Pratt Food Co., Buffalo, N. Y.....	*Bristol:* Bristol Grain & Supply Co.....	10.48	4.88	8.50	6.50	9.15	12.00	64.36	2.63	1.50

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1928—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*		%	%	%	%	%	%	%	%	%
	Horse Feed, etc.—Concluded.										
8565	*Horse Power.* Quaker Oats Co., Chicago, Ill.	*Seymour:* Seymour Grain & Coal Co.	8.00	4.88	11.19	11.00	8.48	11.00	64.15	3.30	2.80
8595	*Vim.* Quaker Oats Co., Chicago, Ill.	*Devon:* Devon Coal & Ice Co.	2.80	6.15	4.25	5.00	29.28	28.00	55.97	1.55	2.00
9975	*Green Cross.* Quaker Oats Co., Chicago, Ill.	*Seymour:* Seymour Grain & Coal Co.	12.25	6.23	11.00	10.00	13.08	12.00	54.84	2.60	2.50
10000	*Sugared Vim.* Quaker Oats Co., Chicago, Ill.	*Plantsville:* C. A. Cowles.	8.62	6.76	5.00	5.00	24.08	25.00	54.32	1.22	1.50
8564	*Purina Bulky-Las.* Ralston Purina Co., St. Louis, Mo.	*Ansonia:* Ansonia Flour & Feed	8.70	7.53	10.13	9.00	16.15	15.00	55.79	1.70	1.30
21	*Purina Omolene.* Ralston Purina Co., St. Louis, Mo.	*Meriden:* H. Grulich.	12.03	3.78	10.88	9.70	6.65	9.00	62.83	3.83	3.20
126	*Purina Hog Fatena.* Ralston Purina Co., St. Louis, Mo.	*Manchester:* Manchester Grain & Coal Co.	11.43	7.51	14.94	14.00	5.80	6.00	56.84	3.48	3.00
192	*Purina Rolled Oats (Steam Cooked).* Ralston Purina Co., St. Louis, Mo.	*Stamford:* Clapboard Hill Feed Co.	8.30	1.77	15.88	16.00	1.33	2.00	66.99	5.73	6.00

392	*Diamond* 85%. Rockville Grain & Coal Co., Rockville, Conn	*Manchester:* Manchester Grain & Coal Co	10.05	3.25	10.44	9.00	7.15	10.00	64.71	4.40	3.00
8761	*Honeysuckle.* Chas. Schaefer & Sons, Brooklyn, N. Y	*Bridgeport:* Conn. Feed Co	6.40	11.35	9.38	6.00	8.79	15.00	61.35	2.73	0.80
9995	*Wirthmore.* St. Albans Grain Co., St. Albans, Vt	*Hamden:* I. W. Beers	13.27	3.33	10.69	9.80	6.88	9.00	62.64	3.19	3.25
214	*Charlestock:.* St. Albans Grain Co., St. Albans, Vt	*Ridgefield:* Ridgefield Lumber Co	9.23	4.02	10.44	9.00	11.40	14.00	60.13	4.78	4.00
143	*Syragold, with Molasses.* Syracuse Milling Co., Syracuse, N. Y	*East Bridgeport:* J. Simon	7.48	4.34	9.81	8.00	10.15	12.00	65.72	2.50	2.50
144	*Jordan, with Molasses.* Syracuse Milling Co., Syracuse, N. Y.	*East Bridgeport:* J. Simon	7.78	6.40	9.50	7.00	12.00	12.00	61.57	2.75	2.00
335	*Syragold Ground Corn and Oat Feed.* Syracuse Milling Co., Syracuse, N. Y	*Colchester:* P. Cutler, Inc	10.63	2.81	11.13	10.00	7.78	9.50	63.00	4.65	4.00
8753	*Neverfail.* Tioga Empire Mills, Waverly, N. Y	*New Britain:* Stanley-Svea Grain Co	11.55	3.58	10.56	10.00	7.13	9.00	63.33	3.85	3.50
8759	*Derby.* Tioga-Empire Mills, Waverly, N. Y	*So. Norwalk:* Roodner Feed Co.	13.80	1.47	8.88	9.02	2.95	3.50	69.05	3.85	3.06
256	*Derby Corn and Oat.* Tioga-Empire Feed Mills, Waverly, N. Y	*Hawleyville:* W. A. Honan	10.13	2.83	10.69	9.20	7.70	8.00	63.62	5.03	4.00
8621	*Special Rosebro.* Vitality Mills, Inc., Chicago, Ill	*East Bridgeport:* Kaplan Feed Co	2.35	4.45	9.25	9.00	6.43	11.00	73.89	3.63	2.00
	Dairy Feeds.										
8477	*Claco.* C. L. Adams Co., Woodbury, Conn	*West Cheshire:* Cheshire Grain & Coal Co	6.20	7.10	22.00	20.00	7.94	9.00	51.81	4.95	5.00
7901	*Amco 20%* (*Flexible Formula.*) American Milling Co., Peoria, Ill	*Middletown:* Charles Dragoo	11.25	7.76	23.25	20.00	6.25	9.00	47.13	4.36	4.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1928—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*		%	%	%	%	%	%	%	%	%
	Dairy Feeds—Continued.										
7903	*Amco 20% National.* American Milling Co., Peoria, Ill.	*Middletown:* Charles Dragoo..	11.05	7.82	21.06	20.00	7.35	9.00	48.29	4.43	4.50
7914	*Amco 24% (Flexible Formula).* American Milling Co., Peoria, Ill.....	*Middletown:* Charles Dragoo..	9.95	7.16	25.56	24.00	7.18	9.00	45.57	4.58	4.00
8574	*Amco 20% (Flexible Formula).* American Milling Co., Peoria, Ill.....	*Newington:* Thos. Holt.....	8.58	8.35	21.00	20.00	5.63	9.00	53.14	3.30	4.00
375	*Amco 24% (Flexible Formula)* American Milling Co., Peoria, Ill.....	*Gildersleeve:* John H. Fay.....	10.30	5.85	22.81	24.00	6.25	9.00	51.41	3.38	4.00
397	*Amco 20% National.* American Milling Co., Peoria, Ill.	*Farmington:* T. E. Stephenson	9.58	8.00	21.19	20.00	8.65	9.00	48.00	4.58	4.00
7814	*Advanced Registry.* Arcady Farms Milling Co., Chicago, Ill.....	*Simsbury:* Woods-Chandler Co.	8.65	6.91	24.44	25.00	9.68	10.00	45.32	5.00	5.00

29	*Advanced Registry.* Arcady Farms Milling Co., Chicago, Ill.	*Simsbury:* Woods-Chandler Co.	9.33	5.27	24.13	25.00	9.83	10.00	46.74	4.70	5.00
394	*Arco 24%.* Arcady Farms Milling Co., Chicago, Ill.	*Colchester:* J. Buratz	9.13	9.11	23.88	24.00	10.00	11.00	42.50	5.38	4.50
7839	*Milkers Ready Ration.* Arcady Farms Milling Co., Chicago, Ill.	*So. Manchester:* Smith Bros.	10.31	8.59	22.81	22.00	9.75	11.00	43.89	4.65	4.00
297	*Milkers Ready Ration.* Arcady Farms Milling Co., Chicago, Ill.	*Colchester:* J. Buratz	8.85	8.91	24.31	22.00	12.50	11.00	39.98	5.45	4.00
30	*Producer 20% Ready Ration.* Arcady Farms Milling Co., Chicago, Ill.	*Simsbury:* Woods-Chandler Co.	9.70	6.69	21.88	20.00	9.65	10.00	48.28	3.80	4.00
370	*Sweet 16.* Arcady Farms Milling Co., Chicago, Ill.	*Danielson:* Dayville Grain Co.	10.18	9.65	15.63	16.00	12.65	12.00	47.34	4.55	4.00
8496	*Wonder.* Arcady Farms Milling Co., Chicago, Ill.	*Plantsville:* Mchmel & Sarvi.	7.70	8.25	25.00	24.00	7.05	10.00	46.55	5.45	5.00
7908	*Bailey's Open Formula 20%.* E. W. Bailey & Co., Montpelier, Vt.	*Merrow:* I. F. Wilcox	9.80	10.41	20.38	20.00	10.43	9.00	44.33	4.65	4.50
7909	*Bailey's Open Formula 24%.* E. W. Bailey & Co., Montpelier, Vt.	*Mansfield Depot:* Martin M. Hansen	10.60	8.18	25.00	24.00	8.43	9.00	42.19	5.60	4.50
298	*Capital.* E. W. Bailey & Co., Swanton, Vt.	*Mansfield Depot:* Martin M. Hansen	9.50	5.28	24.13	24.00	8.30	9.00	47.86	4.93	4.50
398	*Favorite.* E. W. Bailey & Co., Swanton, Vt.	*West Willington:* H. M.Hansen	8.63	6.69	23.31	20.00	7.28	7.50	49.79	4.30	4.50
7936	*Beacon 20.* Beacon Milling Co., Inc., Cayuga, N. Y.	*New Milford:* W. L. Richmond & Son	9.60	6.26	20.00	20.00	8.50	9.00	51.04	4.60	5.00
9952	*Auburn Dairy Feed.* Beacon Milling Co., Inc., Cayuga, N. Y.	*Shelton:* Shelton Feed Co.	10.41	7.41	20.38	20.00	7.30	10.00	50.26	4.24	4.50

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1928—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*		%	%	%	%	%	%	%	%	
	Dairy Feeds—Continued.										
28	*Beacon Sweet 24.* Beacon Milling Co., Inc., Cayuga, N. Y.	*New Britain:* C. W. Lines Co.	9.55	6.66	23.88	24.00	7.80	9.00	48.03	4.08	4.50
396	*Beacon Sweet 24.* Beacon Milling Co., Inc., Cayuga, N. Y.	*Danbury:* C. S. Barnum & Son	9.00	6.91	25.13	24.00	7.50	9.00	47.81	3.65	4.50
169	*Beacon.* Beacon Milling Co., Inc., Cayuga, N. Y.....	*Danbury:* C. S. Barnum & Son	8.65	7.89	24.00	24.00	8.85	10.00	46.01	4.60	5.00
7795	*Beers.* I. W. Beers, Hamden, Conn.....	*Hamden:* I. W. Beers.....	11.30	4.93	20.25	19.00	7.61	8.00	51.30	4.61	3.75
7821	*Success.* A. D. Bridges' Sons, Hazardville, Conn.....	*Hazardville:* A. D. Bridges' Sons	9.65	5.17	21.63	20.00	9.50	....	49.24	4.81	5.20
8560	*Success.* A. D. Bridges' Sons, Hazardville, Conn.....	*Hazardville:* A. D. Bridges' Sons	8.00	4.90	21.06	20.00	8.89	9.50	51.82	5.33	5.00
193	*L. B. Milk Ration.* L. Broder, Colchester, Conn.....	*Colchester:* L. Broder.....	9.00	6.78	20.19	20.00	6.85	8.50	51.63	5.55	5.50
8212	*C. B.* C. Buckingham & Co., Southport, Conn.....	*Southport:* C. Buckingham & Co.	6.58	7.59	25.13	22.82	9.08	9.40	46.79	4.83	4.61

301	*No-Botheration.* C. W. Campbell Co., Stonington, Conn.	*Groton:* C. W. Campbell Co...	9.33	6.28	20.00	20.00	7.10	9.00	52.16	5.13	5.00
5	*Ajax 16%.* Chapin & Co., Chicago, Ill.	*Plantsville:* C. A. Cowles.....	10.58	9.02	16.00	16.00	8.80	12.00	52.45	3.15	3.00
7929	*Ajax 20%.* Chapin & Co., Chicago, Ill.	*East Winsted:* Leonard Grain Co.	10.26	11.39	21.88	20.00	8.15	12.00	43.54	4.78	4.50
162	*Ajax 24%.* Chapin & Co., Chicago, Ill.	*Danbury:* F. C. Benjamin....	9.35	9.04	25.19	24.00	8.38	12.00	43.59	4.45	4.50
8682	*Fortune 20% Molasses.* The Coles Co., Middletown, Conn.	*Middletown:* The Coles Co....	7.10	6.66	20.75	20.00	6.83	9.00	53.91	4.75	4.00
8549	*Fortune 24% Molasses.* The Coles Co., Middletown, Conn.	*Plantsville:* Mehmel & Sarvi...	8.15	6.38	24.13	24.00	9.20	9.00	47.16	4.98	4.50
8487	*Unicorn.* Chapin & Co., Chicago, Ill.	*Plantsville:* C. A. Cowles.....	8.55	10.22	23.81	24.00	7.13	10.00	45.09	5.20	5.00
8016	*Gecco.* G. E. Conkey Co., Cleveland, Ohio.	*Ansonia:* A. Hodos & Son....	10.03	6.18	22.00	20.00	6.40	9.00	50.49	4.90	4.50
9971	*Conkey's Gecco 20%.* G. E. Conkey Co., Cleveland, Ohio	*Ansonia:* A. Hodos & Son....	10.20	5.43	21.88	20.00	8.00	9.00	49.54	4.95	4.50
7802	*Cowles 24%.* C. A. Cowles, Plantsville, Conn.	*Plantsville:* C. A. Cowles.....	9.70	5.31	24.50	24.00	8.31	10.00	46.10	6.08	6.00
8547	*Cowles 24%.* C. A. Cowles, Plantsville, Conn.	*Plantsville:* C. A. Cowles.....	6.85	4.99	23.56	24.00	8.33	10.00	50.67	5.60	6.00
9946	*Crosby's Balanced Ration.* Crosby Milling Co., Brattleboro, Vt.	*Shelton:* Wolf Savitsky.....	9.65	6.79	25.13	25.00	7.65	9.00	45.45	5.33	5.50
9950	*Crosby's Ready Ration.* Crosby Milling Co., Brattleboro, Vt.	*Shelton:* Wolf Savitsky.....	10.30	5.33	20.88	20.00	8.65	10.00	49.30	5.54	5.00
8281	*20% Open Formula.* R. G. Davis & Son. New Haven, Conn.	*Ansonia:* Ansonia Flour & Grain Co.	9.30	6.59	20.75	20.00	8.00	8.00	51.08	4.28	4.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1928—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*		%	%	%	%	%	%	%	%	
	Dairy Feeds—Continued.										
8562	*Basic Dairy Ration.* R. G. Davis & Sons, New Haven, Conn.	*Ansonia:* Ansonia Flour & Grain Co.	9.15	5.02	19.69	20.00	8.43	9.00	53.21	4.50	4.50
8750	*Delaware.* Delaware Mills, Deposit, N. Y.	*Southington:* Southington Lumber Co.	7.20	7.22	23.13	23.00	8.55	10.00	48.75	5.15	5.00
286	*Delco 20%.* Delaware Mills, Deposit, N. Y.	*Winsted:* C. R. Hawley	8.80	8.59	21.81	20.00	9.05	11.00	47.47	4.28	4.00
7949	Devon Coal & Ice Co., Devon, Conn.	*Devon:* Devon Coal & Ice Co.	11.50	6.51	20.13	22.00	8.45	9.00	48.66	4.75	4.00
8718	Devon Coal & Ice Co., Devon, Conn.	*Devon:* Devon Coal & Ice Co.	7.45	6.06	23.06	22.00	7.93	9.00	50.35	5.15	4.00
8648	*Eastern States Ful Pail Open Formula.* Eastern States Farmers' Exchange, Springfield, Mass.	*North Haven:* Ridgewood Farm	8.25	7.33	20.44	20.00	7.08	8.00	52.55	4.35	4.00

8650	*Eastern States Fitting Ration Open Formula.* Eastern States Farmers' Exchange, Springfield, Mass.	*North Haven:* Ridgewood Farm	9.45	6.59	13.00	12.00	6.43	7.00	59.03	5.50	3.50
8791	*Eastern States Milkmore (Open Formula.)* Eastern States Farmers' Exchange, Springfield, Mass.	*Watertown:* Watertown Co-op. Assoc.	7.10	7.62	23.31	24.00	7.65	8.00	49.62	4.70	4.50
7932	*Emco.* Elmore Milling Co., Oneonta, N. Y.	*Winsted:* Chas. R. Hawley	10.30	4.69	21.44	20.00	9.98	10.00	48.66	4.93	4.50
232	*Elmore Milk Grains.* Elmore Milling Co., Oneonta, N. Y.	*Hazardville:* A. D. Bridges' Sons	8.78	7.22	24.38	25.00	9.75	11.00	45.22	4.65	5.00
290	*Elmore Waldorf Formula.* Elmore Milling Co., Oneonta, N. Y.	*Newtown:* R. H. Holcomb & Co.	9.25	5.99	21.00	20.00	8.33	10.00	51.28	4.15	3.50
289	*Otsego Economy.* Elmore Milling Co., Oneonta, N. Y.	*Shelton:* Wolf Savitsky	8.38	8.87	22.88	20.00	8.08	11.00	48.66	3.13	4.00
7588	*Golden Rod 25%.* John W. Eshelman & Sons, Lancaster, Pa.	*Brookfield:* W. L. Richmond & Son	10.01	8.50	25.19	25.00	10.35	11.00	40.59	5.36	5.00
8755	*Lancaster 20.* John W. Eshelman & Sons, Lancaster, Pa.	*South Norwalk:* Roodner Feed Co.	10.55	7.00	20.00	20.00	8.53	11.00	49.87	4.05	4.00
8554	*Red Rose 24.* John W. Eshelman & Sons, Lancaster, Pa.	*Plainville:* W. S. Eaton	7.23	6.07	24.19	24.00	10.18	11.00	47.43	4.90	4.00
9926	*Pennsy 16.* John W. Eshelman & Sons, Lancaster, Pa.	*Devon:* Devon Coal & Ice Co.	10.90	7.95	17.25	16.00	8.78	11.00	51.51	3.61	3.00
17	*Open Formula 20%.* John W. Eshelman & Sons, Lancaster, Pa.	*New Haven:* Moran-Patton Co.	10.98	6.73	20.63	20.00	8.15	9.00	49.81	3.70	4.50
313	*Open Formula 20%.* John W. Eshelman & Sons, Lancaster, Pa.	*New Haven:* Moran-Patton Co.	9.93	7.16	22.50	20.00	8.38	9.00	47.73	4.30	4.50
110	*R. Own.* A. W. Forbes, East Haven, Conn.	*East Haven:* A. W. Forbes	10.00	5.09	21.88	20.00	6.28	9.00	53.78	2.97	4.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1928—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*		%	%	%	%	%	%	%	%	%
	Dairy Feeds—Continued.										
399	*R. Own.* A. W. Forbes, East Haven, Conn.	*East Haven:* A. W. Forbes.	9.58	6.66	22.00	20.00	7.53	9.00	50.08	4.15	4.00
7915	*Grandin's 12 Twin Six 12.* D. H. Grandin Milling Co., Jamestown, N. Y.	*Quinnebaug:* M. T. Dart	9.75	5.90	22.38	22.00	9.28	12.00	47.92	4.77	5.00
7822	*"Hudson's".* L. W. Hudson, Windsor, Conn.	*Windsor:* L. W. Hudson	10.16	5.24	18.38	20.00	8.50	8.00	52.57	5.15	5.50
9789	*"Hudson's".* L. W. Hudson, Windsor, Conn.	*Windsor:* L. W. Hudson	10.50	5.22	19.00	20.00	8.36	7.00	52.14	4.78	5.50
235	*"Hudson's".* L. W. Hudson, Windsor, Conn.	*Windsor:* L. W. Hudson	9.55	5.51	17.63	20.00	8.55	7.00	54.03	4.73	5.50
116	*H & H.* Hales & Hunter Co., Chicago, Ill.	*Highwood:* T. C. Hadden & Co.	10.25	6.55	22.00	20.00	7.05	9.00	50.27	3.88	4.00
291	*Apex Milk Maker.* Kasco Mills Inc., Waverly, N. Y.	*East Winsted:* Leonard Grain Co.	8.30	7.19	21.38	20.00	8.80	11.00	49.58	4.75	4.50
7930	*Beats All Milk Grains.* Kasco Mills Inc., Waverly, N. Y.	*East Winsted:* Leonard Grain Co.	9.80	5.68	21.69	22.00	8.70	10.00	49.30	4.83	4.50

292	*Beats All Milk Grains.* Kasco Mills Inc., Waverly, N. Y..	*East Winsted:* Leonard Grain Co.....	7.95	8.19	22.00	22.00	9.03	10.00	47.93	4.90	4.50
9790	*Badger 16½% Sweet.* Chas. A. Krause Milling Co., Milwaukee, Wis.....	*Thomaston:* I. Levy.....	10.85	6.80	15.81	16.50	12.15	13.00	49.86	4.53	5.00
8846	*Larro Ready Ration.* Larrowe Milling Co., Detroit, Mich..	*Bristol:* Bristol Grain & Supply	8.80	5.97	20.69	20.00	10.60	12.00	50.09	3.85	4.00
7811	*Mill Pride.* C. W. Lines Co., New Britain, Conn.....	*New Britain:* C. W. Lines Co..	9.20	7.14	26.63	24.00	8.33	10.00	44.35	4.35	5.50
8207	*Mill Pride.* C. W. Lines Co., New Britain, Conn.....	*New Britain:* C. W. Lines Co..	7.25	7.01	24.50	24.00	7.13	10.00	49.48	4.63	5.00
7927	*Common Sense.* Litchfield Co-op. Assoc., Torrington, Conn.	*Torrington:* Litchfield Co-op. Assoc.....	8.58	7.27	22.38	20.00	9.30	9.50	46.49	5.98	5.00
237	*Common Sense.* Litchfield Co-op. Assoc., Torrington, Conn.	*Torrington:* Litchfield Co-op. Assoc.....	9.78	7.50	20.00	20.00	8.80	9.50	49.27	4.65	5.00
166	*Square Deal.* Long Hill Feed Store, Long Hill, Conn.....	*Long Hill:* Long Hill Feed Store	8.10	7.41	20.88	20.00	11.15	10.00	48.05	4.41	5.00
239	*Red Star.* E. Manchester & Sons, Winsted, Conn.....	*Winsted:* E. Manchester & Sons	8.70	8.89	24.63	23.00	8.03	10.00	45.07	4.68	4.00
247	*Marmico (with Molasses).* Maritime Milling Co., Buffalo, N. Y.....	*Riverton:* L. A. Coe.....	10.48	6.49	15.38	16.00	10.15	12.00	53.82	3.68	4.00
296	*Red-E-Mixt (Sweetened).* Maritime Milling Co., Buffalo, N. Y.....	*New Milford:* Geo. E. Ackley & Co.....	9.75	5.13	22.63	20.00	8.73	10.00	49.98	3.78	5.00
8497	*Red Wing Special.* Meech & Stoddard Inc., Middletown, Conn.....	*Plantsville:* Mehmel & Sarvi...	7.08	6.10	22.81	24.00	8.36	9.00	49.02	6.63	5.50
8802	*Red Wing.* Meech & Stoddard Inc., Middletown, Conn....	*Middlefield:* Middlefield Grain & Coal Co.....	6.20	6.58	20.31	20.00	8.28	9.00	52.53	6.10	5.50
122	*Moon's 24%.* Geo. Q. Moon & Co., Binghamton, N. Y....	*Manchester:* I. P. Campbell...	9.05	7.48	23.81	24.00	7.95	10.00	46.31	5.40	5.00
125	*Moon's X.* Geo. Q. Moon & Co., Binghamton, N. Y....	*Manchester:* I. P. Campbell...	10.13	8.17	16.06	16.00	13.83	12.00	48.32	3.49	4.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1928—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*		%	%	%	%	%	%	%	%	%
	Dairy Feeds—Continued.										
8316	*Old Mill.* Fred C. Morse, Guilford, Conn.	*Guilford:* Fred C. Morse	7.25	7.08	22.25	23.00	8.48	9.00	49.69	5.25	5.00
9921	*20% Open Formula.* Fred C. Morse, Guilford, Conn.	*Guilford:* Fred C. Morse	10.64	7.18	20.06	20.00	8.05	9.00	49.59	4.48	4.50
4	*Institutional 20% Sweet.* Newton Feed Co., Milwaukee, Wis.	*Plantsville:* C. A. Cowles	11.00	8.34	18.75	20.00	8.63	12.00	50.28	3.00	3.00
401	*Institutional 20% Sweet.* Newton Feed Co., Milwaukee, Wis.	*Farmington:* Winchell Smith	10.58	7.78	20.38	20.00	10.55	12.00	47.56	3.15	3.00
179	*Institutional 24% Sweet.* Newton Feed Co., Milwaukee, Wis.	*Plantsville:* C. A. Cowles	10.60	6.92	21.38	24.00	9.98	14.00	47.79	3.33	3.00
8726	*Newtrio 16%.* Newton Feed Co., Milwaukee, Wis.	*Plantsville:* C. A. Cowles	7.90	5.33	16.88	16.00	8.38	9.00	56.48	5.03	5.00
8210	*Newtrio 20%.* Newton Feed Co., Milwaukee, Wis.	*Plantsville:* C. A. Cowles	4.88	7.35	19.75	20.00	8.25	9.00	54.18	5.59	5.00

8575	*Newtrio 20%.* Newton Feed Co., Milwaukee, Wis.....	*Newington:* Thos. Holt.....	6.75	6.66	18.13	20.00	7.60	9.00	55.78	5.08	5.00
8749	*Newtrio 24%.* Newton Feed Co., Milwaukee, Wis.....	*Plantsville:* C. A. Cowles.....	9.50	8.38	21.94	24.00	7.25	9.00	47.83	5.10	5.00
8211	*Newtrio Growing & Fitting Ration.* Newton Feed Co., Milwaukee, Wis.....	*Plantsville:* C. A. Cowles.....	5.18	8.29	14.25	12.00	7.51	9.00	59.62	5.15	5.00
7851	*Domino Butterine.* Nowak Milling Corp., Hammond, Ind.....	*Higganum:* F. A. Petrofsky...	10.76	9.75	17.63	17.00	9.03	13.50	48.18	4.65	4.00
51	*Domino 24½.* Nowak Milling Corp., Hammond, Ind.....	*Bloomfield:* Bloomfield Farmers' Exchange.....	8.38	7.62	27.25	24.50	7.90	10.00	45.12	3.73	5.00
373	*Domino 24½.* Nowak Milling Corp., Hammond, Ind.....	*Bloomfield:* Bloomfield Farmers' Exchange.....	8.30	7.79	26.00	24.50	8.18	10.00	45.05	4.68	5.00
8669	*Uncle John's 24% Cream Pot.* Ontario Milling Co., Oswego, N. Y.....	*Meriden:* H. Grulich.....	7.80	6.70	23.06	24.00	6.88	9.00	49.83	5.73	5.50
8681	*Big Value.* Ontario Milling Co., Oswego, N. Y.....	*East Wallingford:* D. W. Ives..	6.10	6.34	20.88	20.00	8.93	10.00	52.20	5.55	4.50
364	*Bet-R-Milk 20%.* Park & Pollard Co., Buffalo, N. Y..	*Moosup:* T. E. Main & Sons..	10.00	6.57	22.88	20.00	7.35	9.00	48.87	4.33	4.00
7916	*Herdhelth 16%.* Park & Pollard Co., Buffalo, N. Y.....	*Moosup:* T. E. Main & Sons..	11.60	10.51	17.69	16.00	11.51	12.00	44.19	4.50	4.00
369	*Herdhelth 16%.* Park & Pollard Co., Buffalo, N. Y.....	*Putnam:* Bosworth Bros.....	10.58	9.15	17.19	16.00	11.00	12.00	48.95	3.13	3.00
8769	*Milk-Maid 24% Sweetened.* Park & Pollard Co., Buffalo, N. Y.....	*Waterbury:* Spencer Grain Co..	9.25	8.45	24.13	24.00	8.05	11.00	45.57	4.55	4.50
7798	*Overall 24%.* Park & Pollard Co., Buffalo, N. Y.....	*West Cheshire:* Cheshire Grain & Coal Co.....	7.70	8.18	25.06	24.00	7.88	9.00	45.88	5.30	6.00
8474	*Overall 24%.* Park & Pollard Co., Buffalo, N. Y.....	*West Cheshire:* Cheshire Grain & Coal Co.....	6.53	6.56	25.13	24.00	7.70	9.00	49.25	4.83	4.50
368	*Top Notch 16%.* Park & Pollard Co., Buffalo, N. Y.....	*Moosup:* T. E. Main & Sons...	9.43	8.99	18.25	16.00	9.93	12.00	50.50	2.90	3.50

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1928—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*		%	%	%	%	%	%	%	%	%
	Dairy Feeds—Continued.										
184	*Pillsbury's.* Pillsbury Flour Mills Co., Minneapolis, Minn.	*New Milford:* Geo. T. Soule...	9.10	6.52	20.50	20.00	7.93	10.00	50.82	5.13	5.00
7817	*Burt's.* Postum Co., Battle Creek, Mich.	*Granby:* E. H. Rollins.....	7.75	6.02	23.13	24.00	8.15	9.00	50.03	4.92	5.00
357	*Pratt's Sweet.* Pratt Food Co., Buffalo, N. Y.	*Norwalk:* Frank Libner & Sons	9.50	7.88	23.13	24.00	8.60	10.00	46.10	4.79	5.00
42	*Producer.* H. C. Puffer Co., Springfield, Mass.	*Simsbury:* Woods, Chandler Co.	8.88	6.71	25.63	24.00	7.33	8.50	46.70	4.75	4.00
8631	*Quaker Big Q 20% Protein.* Quaker Oats Co., Chicago, Ill.	*Norwalk:* Frank Libner & Sons	5.10	6.75	19.31	20.00	11.90	12.00	53.64	3.30	3.25
187	*Quaker 16% Protein.* Quaker Oats Co., Chicago, Ill.	*Norwalk:* Frank Libner & Sons	9.33	6.52	15.75	16.00	14.18	13.50	50.82	3.40	4.00
186	*Quaker Boss 24% Protein.* Quaker Oats Co., Chicago, Ill.	*Norwalk:* Frank Libner & Sons	9.48	7.41	24.88	24.00	9.68	10.50	43.67	4.88	4.00

7816	*Blue Checker Cow Chow.* Ralston Purina Co., St. Louis, Mo...	*Granby:* E. H. Rollins.....	10.30	7.28	22.00	20.00	10.93	12.00	46.99	2.50	3.00
8561	*Blue Checker Cow Chow.* Ralston Purina Co., St. Louis, Mo...	*Ansonia:* Ansonia Flour & Feed Co.....	9.58	7.21	21.63	20.00	11.30	12.00	46.10	4.18	3.20
8671	*Purina Cow Chow.* Ralston Purina Co., St. Louis, Mo..	*Meriden:* H. Grulich.....	7.05	7.46	25.38	24.00	10.35	12.00	45.71	4.05	4.00
20	*Purina Buffalo Green Checker 24% Cow Chow.* Ralston Purina Co., St. Louis, Mo..	*Meriden:* H. Grulich.....	10.00	7.56	25.13	24.00	11.18	12.00	42.54	3.59	2.30
212	*Purina Orange Checker Cow Chow.* Ralston Purina Co., St. Louis, Mo.....	*Ridgefield:* Ridgefield Lumber Co.....	10.48	6.73	18.88	16.00	9.58	12.00	51.33	3.00	3.00
191	*Protena.* Ralston Purina Co., St. Louis, Mo.....	*Norwalk:* Clapboard Hills Feed Co.....	9.65	7.41	17.25	16.50	11.05	12.00	50.56	4.08	3.50
389	*Diamond 24%.* Rockville Grain & Coal Co., Rockville, Conn.....	*Manchester:* Manchester Grain & Coal Co.....	9.15	8.17	26.44	24.00	6.88	11.00	46.18	3.18	4.00
9787	*See More Milk.* Seymour Grain & Coal Co., Seymour, Conn.	*Seymour:* Seymour Grain & Coal Co.....	9.83	6.58	20.44	20.00	8.70	9.00	49.25	5.20	4.50
7809	*Mill Stream 20%.* Winchell Smith, Farmington, Conn. .	*Farmington:* Winchell Smith..	10.35	6.29	19.56	20.00	8.35	8.00	50.80	4.65	5.00
7810	*Mill Stream Boomerang.* Winchell Smith, Farmington, Conn.....	*Farmington:* Winchell Smith..	11.00	5.49	22.19	24.00	5.57	10.00	50.80	4.95	6.00
101	*Mill Stream Boomerang.* Winchell Smith, Farmington, Conn.....	*Farmington:* Winchell Smith..	10.73	5.25	22.06	24.00	6.05	10.00	51.51	4.40	6.00
403	*Mill Stream Boomerang.* Winchell Smith, Farmington, Conn.....	*Farmington:* Winchell Smith..	9.68	5.54	21.88	24.00	6.33	10.00	52.09	4.48	6.00
8278	*Paragon Sweetened.* St. Albans Grain Co., St. Albans, Vt...	*New Milford:* Geo. T. Soule..	5.38	8.61	23.56	22.00	10.50	12.00	47.25	4.70	4.00
9956	*Paragon Sweetened.* St. Albans Grain Co., St. Albans, Vt...	*Ansonia:* Ansonia Flour & Feed	10.24	11.53	21.94	22.00	10.00	12.00	42.14	4.15	4.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1928—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*		%	%	%	%	%	%	%	%	%
	Dairy Feeds—Continued.										
215	*Paragon.* St. Albans Grain Co., St. Albans, Vt.	*New Milford:* Geo. T. Soule	8.35	7.22	23.25	22.00	11.65	12.00	45.23	4.30	4.00
7907	*Hygrade.* St. Albans Grain Co., St. Albans, Vt.	*Willimantic:* Willimantic Grain Co.	11.00	8.92	19.63	20.00	7.33	8.50	48.67	4.45	4.50
8639	*Hygrade Sweetened.* St. Albans Grain Co., St. Albans, Vt.	*North Haven:* W. L. Thorpe	7.53	9.10	19.50	20.00	6.30	8.50	53.17	4.40	4.50
9983	*Hygrade Sweetened 16%.* St. Albans Grain Co., St. Albans, Vt.	*Southbury:* H. R. Stone	11.90	7.12	17.81	16.00	7.13	9.00	51.79	4.25	3.75
353	*King Sweetened.* St. Albans Grain Co., St. Albans, Vt.	*Willimantic:* Willimantic Grain Co.	9.50	7.41	22.19	22.00	8.73	9.00	47.99	4.18	4.50
7	*Wirthmore with Beet Pulp.* St. Albans Grain Co., St. Albans, Vt.	*Plantsville:* C. A. Cowles	9.78	7.24	21.00	21.00	8.23	11.00	49.47	4.28	4.50
7819	*Wirthmore 16% Summer Ration.* St. Albans Grain Co., St. Albans, Vt.	*Thompsonville:* Geo. S. Phelps & Co.	10.40	10.79	18.50	16.00	6.38	8.50	49.65	4.28	4.00

388	*Wirthmore 16% Sweetened.* St. Albans Grain Co., St. Albans, Vt.	*Stepney* M. Nusbaum	9.75	10.89	17.63	16.00	6.63	8.50	51.42	3.68	4.00
9955	*Wirthmore 20%.* St. Albans Grain Co., St. Albans, Vt.	*Ansonia:* Ansonia Flour & Feed Co.	10.52	4.93	20.38	20.00	7.08	8.50	52.31	4.78	5.00
8576	*Wirthmore 20% Sweetened.* St. Albans Grain Co., St. Albans, Vt.	*Newington:* Thos. Holt	7.93	5.84	20.94	20.00	6.58	8.00	54.06	4.65	5.00
331	*Wirthmore 20% Sweetened.* St. Albans Grain Co., St. Albans, Vt.	*Stepney:* M. Nusbaum	8.78	5.97	20.75	20.00	7.95	8.00	51.45	5.10	5.00
7793	*Wirthmore 25% Protein Balanced Ration.* St. Albans Grain Co., St. Albans, Vt.	*Hamden:* I. W. Beers	10.65	7.73	24.38	25.00	6.40	9.00	45.74	5.10	5.50
8678	*Wirthmore 25% Protein Balanced Ration.* St. Albans Grain Co., St. Albans, Vt.	*Kensington:* S. F. Labieniec	5.98	6.39	25.63	25.00	7.85	9.00	48.95	5.20	5.00
8311	*Wirthmore 25% Balanced Ration, Sweetened.* St. Albans Grain Co., St. Albans, Vt.	*Branford* S. V. Osborn, Est.	6.10	10.56	27.81	25.00	6.80	8.50	43.58	5.15	5.00
333	*Onondaga.* Syracuse Milling Co., Syracuse, N. Y.	*Colchester:* P. Cutler Inc	7.73	6.08	20.38	20.00	12.03	12.00	49.00	4.78	4.00
46	*Syragold.* Syracuse Milling Co., Syracuse, N. Y.	*Granby:* E. H. Rollins	8.55	5.40	23.75	24.00	9.83	12.00	47.59	4.88	4.50
255	*Syragold Milk Ration.* Syracuse Milling Co., Syracuse, N. Y.	*Manchester:* Little & McKinney	8.68	5.91	20.25	20.00	9.08	12.00	51.45	4.63	4.00
7924	*Talcott's Economy.* D. L. Talcott, Torrington, Conn.	*Torrington:* D. L. Talcott	9.43	6.75	22.69	23.00	8.90	9.00	47.63	4.60	4.50
8797	*Thomaston.* Thomaston Supply Co., Thomaston, Conn.	*Thomaston:* Thomaston Supply Co.	6.98	7.41	21.31	20.00	8.23	8.00	48.57	7.50	6.00
259	*E-Gee.* Tioga Empire Feed Mills, Waverly, N. Y.	*Hawleyville:* W. A. Honan	9.53	6.94	22.13	20.00	8.55	10.00	49.35	3.50	3.50

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1928—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*		%	%	%	%	%	%	%	%	%
	Dairy Feeds—Concluded.										
8320	*Red Brand Ti-O-Ga.* Tioga-Empire Feed Mills, Waverly, N. Y.	*Guilford:* Fred H. Rolf	6.83	6.67	24.88	24.00	8.33	10.00	48.84	4.45	5.00
8616	*Red Brand Ti-O-Ga.* Tioga-Empire Feed Mills, Waverly, N. Y.	*Southport:* C. Buckingham Co.	5.65	6.88	24.25	24.00	8.03	10.00	50.14	5.05	5.00
383	*Ubiko Union Grains 20% Sweet.* Ubiko Milling Co., Cincinnati, Ohio	*Lebanon:* Berkman Grain Co.	9.35	7.83	20.38	20.00	8.13	10.00	49.08	5.23	4.00
380	*Ubiko Union Grains 24% Sweet.* Ubiko Milling Co., Cincinnati, Ohio	*Lebanon:* Berkman Grain Co.	9.05	7.53	24.13	24.00	7.90	10.00	46.81	4.58	5.00
381	*Union Grains Ubiko Biles Ready Dairy Ration.* Ubiko Milling Co., Cincinnati, Ohio	*Lebanon:* Berkman Grain Co.	8.10	8.31	24.25	24.00	8.38	10.00	46.01	4.95	5.00
8701	*Vitality 24%.* Vitality Mills, Inc., Chicago, Ill.	*East Bridgeport:* Kaplan Feed Co.	9.93	11.23	22.88	24.00	8.38	10.00	43.63	3.95	5.00

8667	*Will Pay.* Vitality Mills, Inc., Chicago, Ill.	*Meriden:* Reliable Grain & Feed Co.	9.10	10.66	19.50	20.00	8.53	9.00	47.96	4.25	5.00
8588	*Wadfeeco.* Wadsworth Feed Co., Warren, Ohio.	*Shelton:* Shelton Feed Co.	7.38	6.07	22.06	24.00	10.30	9.00	49.69	4.50	5.00
8589	*Wadsworth Special.* Wadsworth Feed Co., Warren, Ohio.	*Shelton:* Shelton Feed Co.	6.18	6.13	21.00	20.00	14.13	12.00	48.26	4.30	5.00
7911	*Abington.* Yantic Grain Co., Norwich, Conn.	*Abington:* Weeks Bros.	9.61	6.24	20.75	20.00	9.98	13.00	50.02	3.40	4.00
338	*Big (Y).* Yantic Grain & Products Co., Norwich, Conn.	*Stafford Springs:* Stafford Grainery	8.60	7.01	24.69	24.00	7.88	10.00	47.19	4.63	5.00
361	*Perfection.* Yantic Grain & Products Co., Norwich, Conn.	*Norwich:* Yantic Grain & Products Co.	7.53	6.99	20.94	20.00	13.10	13.00	47.21	4.23	4.50
339	*Uncas.* Yantic Grain & Products Co., Norwich, Conn.	*Willimantic:* Boston Grain Co.	8.85	6.10	21.00	20.00	8.33	9.00	50.69	5.03	5.00
	Stock Feeds.										
8578	*Amco 12% Fitting Ration.* American Milling Co., Peoria, Ill.	*Newington:* Thos. Holt	4.75	4.02	14.31	12.00	7.58	9.00	64.99	4.35	4.50
7813	*Peerless Milk Ration.* Arcady Farms Milling Co., Chicago, Ill.	*Simsbury:* Woods-Chandler Co.	9.11	9.18	22.13	20.00	12.25	12.00	42.31	5.02	4.00
299	*Pennant.* E. W. Bailey, Swanton, Vt.	*New London:* B. J. McCarthy	10.55	4.27	9.75	9.50	8.28	9.50	62.57	4.58	4.50
7844	*Fortune.* The Coles Co., Middletown, Conn.	*Middletown:* The Coles Co.	9.40	3.61	8.88	9.00	11.70	11.00	61.41	5.00	5.00
105	*Fortune.* The Coles Co., Middletown, Conn.	*Middletown:* The Coles Co.	11.15	2.90	8.50	9.00	9.80	11.00	64.21	3.44	3.50
9945	*Crosby's.* Crosby Milling Co., Brattleboro, Vt.	*Shelton:* Wolf Savitsky	10.01	5.23	10.25	9.00	10.30	12.00	59.66	4.55	4.00
8591	*Davis.* R. G. Davis & Sons, New Haven, Conn.	*Milford:* Milford Grain Co.	7.50	4.04	12.13	10.50	9.63	14.00	63.39	3.31	2.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1928—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*		%	%	%	%	%	%	%	%	%
	Stock Feeds—Concluded.										
8812	*Delaware.* Delaware Mills, Deposit, N. Y.	*Southington:* Southington Lumber Co	6.95	5.92	8.81	9.00	13.93	12.00	61.04	3.35	3.00
8719	*Devon Sweet Stock Feed.* Devon Coal & Ice Co., Devon, Conn.	*Devon:* Devon Coal & Ice Co.	7.00	5.48	9.50	8.00	15.60	16.00	59.07	3.35	2.50
234[1]	*Eshelman's.* John W. Eshelman & Son, Lancaster, Pa.	*South Manchester:* Smith Bros.	9.48	3.84	9.13	9.00	9.48	11.00	64.70	3.37	3.00
441	*Bull Brand Stock Feed.* Maritime Milling Co., Buffalo, N. Y.	*New Milford:* Geo. E. Ackley Co	9.12	4.22	9.50	9.50	13.45	11.00	59.23	4.48	3.50
7838	*Red Wing.* Meech & Stoddard Inc., Middletown, Conn.	*East Hartford:* Meech Grain Co.	9.40	3.78	10.69	9.00	9.13	12.00	62.30	4.70	3.00
9993	*Red Wing.* Meech & Stoddard Inc., Middletown, Conn.	*Highwood:* T. C. Hadden & Co.	10.13	4.38	9.63	9.00	9.38	12.00	62.73	3.75	3.00
9932	*Moon's.* Geo. Q. Moon & Co., Binghamton, N. Y.	*Stratford:* Z. C. Ingersoll	8.65	5.46	11.44	9.00	11.50	12.00	58.06	4.89	3.00
8670	*Uncle John's.* Ontario Milling Co., Oswego, N. Y.	*Meriden:* H. Grulich	7.60	4.43	11.19	9.50	11.85	12.00	61.53	3.40	3.00

[1] Wire tags illegal.

8480	*The Park & Pollard.* The Park & Pollard Co., Buffalo, N. Y.	*Plainville:* F. B. Newton.....	5.90	5.49	9.06	8.00	8.95	12.00	66.25	4.35	2.50
182	*Feed Meal.* The Park & Pollard Co., Buffalo, N. Y.....	*Newtown:* R. H. Holcomb & Co.	10.45	1.75	9.88	9.00	4.35	4.00	69.37	4.20	2.50
7807	*Richford White Diamond.* Quaker Oats Co., Chicago, Ill...	*Plainville:* W. S. Eaton.....	9.15	4.50	8.94	9.00	14.10	14.00	58.31	5.00	3.00
8192	*Quaker Sugared Schumacher.* Quaker Oats Co., Chicago, Ill.....	*Hamden:* I. W. Beers.....	7.92	5.82	9.69	10.00	10.23	12.00	63.21	3.13	3.25
8617	*Quaker Schumacher.* Quaker Oats Co., Chicago, Ill.....	*Southport:* C. Buckingham Co.	3.50	4.14	11.00	10.00	11.45	12.00	66.06	3.85	3.25
359	*White Star, Fine.* Quaker Oats Co., Chicago, Ill.....	*Southport:* C. Buckingham Co.	7.93	4.08	8.94	9.00	14.70	14.00	60.47	3.88	3.00
330	*King.* St. Albans Grain Co., St. Albans, Vt.....	*Willimantic:* Willimantic Grain Co.....	9.43	4.19	10.00	9.00	8.33	10.00	62.27	5.78	4.00
8665	*Wirthmore.* St. Albans Grain Co., St. Albans, Vt.....	*Meriden:* West End Poultry Supply.....	9.75	2.72	8.31	9.00	5.75	9.50	70.22	3.25	4.00
26	*Syragold.* Syracuse Milling Co., Syracuse, N. Y.....	*Kensington:* S. F. Labieniec..	10.28	4.67	9.88	9.00	8.95	12.00	62.52	3.70	3.00
340	*Uncas.* Yantic Grain & Products Co., Norwich, Conn...	*Stafford Springs:* Stafford Grainery.....	9.28	4.35	9.38	9.00	10.15	12.00	62.34	4.50	4.00
	Calf Feeds, Etc.										
7905	*Amco.* American Milling Co., Peoria, Ill.....	*Middletown:* Charles Dragoo..	9.93	6.55	22.81	22.00	3.90	4.00	52.78	4.03	3.00
7946	*Beacon.* Beacon Milling Co., Inc., Cayuga, N. Y.....	*Botsford:* G. T. Rasmussen...	10.85	4.19	24.63	25.00	3.80	6.00	53.23	3.30	3.00
223	*Beacon.* Beacon Milling Co., Inc., Cayuga, N. Y.....	*Botsford:* G. T. Rasmussen...	10.10	4.49	26.13	25.00	4.18	6.00	51.75	3.35	3.00
104	*Blatchford's.* Blatchford Calf Meal Co., Waukegan, Ill...	*Middletown:* Meech & Stoddard, Inc.....	9.84	7.41	25.75	24.00	5.83	6.75	46.99	4.18	5.00
371	*Blatchford's.* Blatchford Calf Meal Co., Waukegan, Ill...	*Middletown:* Meech & Stoddard, Inc.....	9.38	8.10	25.94	24.00	5.50	6.75	46.79	4.29	5.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1928—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.* *Calf Feeds, Etc.—Concluded.*		%	%	%	%	%	%	%	%	%
9949	*Elmore Three Point.* Elmore Milling Co., Oneonta, N. Y.	*Shelton:* Wolf Savitsky.....	10.43	5.61	27.13	24.00	3.90	4.00	49.80	3.13	4.00
180	*Milkade.* The Park & Pollard Co., Buffalo, N. Y.....	*Danbury:* C. S. Barnum & Son	7.90	9.10	23.81	20 00	5.35	7.50	46.69	7.15	7.00
323	*Schumacher's.* Quaker Oats Co., Chicago, Ill.....	*Manchester:* Little & McKinney	7.75	5.32	19.25	18.00	3.40	4.00	56.50	7.78	8.00
325	*Quaker Pig-N-Hog Meal.* Quaker Oats Co., Chicago, Ill...	*Rockville:* Rockville Milling Co.	9.10	8.43	18.63	18.00	6.28	7.00	53.53	4.03	4.00
15	*Purina Pig Chow.* Ralston Purina Co., St. Louis, Mo.....	*New Haven:* Moran-Patton Co.	11.40	7.96	20.63	20.00	6.88	7.00	49.18	3.95	3.20
19	*Purina Calf Chow.* Ralston Purina Co., St. Louis, Mo.....	*New Haven:* Moran-Patton Co.	10.67	5.60	27.75	27.00	3.13	4.50	49.76	3.09	3.20
8592	*Wirthmore Pig Feed.* St. Albans Grain Co., St. Albans, Vt.....	*Milford:* Milford Grain Co...	1.25	8.96	17.81	17.00	6.63	9.00	60.25	5.10	4.00

8593	*Wirthmore Hog Feed.* St. Albans Grain Co., St. Albans, Vt..	*Milford:* Milford Grain Co...	6.20	8.44	21.81	17.00	6.00	7.00	52.40	5.15	4.50
9990	*Tioga.* Tioga-Empire Feed Mills, Waverly, N. Y.....	*Southbury:* H. R. Stone.....	10.48	6.55	23.25	21.00	4.93	7.00	49.87	4.92	4.00
	Poultry Feeds.										
7904	*Amco Egg Mash.* American Milling Co., Peoria, Ill.....	*Middletown:* Charles Dragoo..	10.45	8.65	20.44	20.00	4.73	7.00	49.80	5.93	4.00
376	*Amco Egg Mash.* American Milling Co., Peoria, Ill.....	*Gildersleeve:* John H. Fay.....	9.78	8.21	20.38	20.00	3.73	7.00	53.00	4.90	4.00
377	*Amco Egg Mash with Dried Buttermilk.* American Milling Co., Peoria, Ill.....	*Gildersleeve:* John H. Fay.....	9.80	6.98	18.25	18.00	4.85	7.00	55.69	4.43	4.00
378	*Amco Starting & Growing Mash with Dried Buttermilk.* American Milling Co., Peoria, Ill.	*Gildersleeve:* John H. Fay.....	9.48	9.19	17.81	17.00	4.63	6.00	54.29	4.60	3.50
7921	*Arcady Scratch Grains.* Arcady Farms Milling Co., Chicago, Ill.....	*Portland:* Earl Prout.....	12.43	1.59	9.81	10.00	2.75	5.00	70.27	3.15	2.50
8491	*Arcady Scratch Grains.* Arcady Farms Milling Co., Chicago, Ill.....	*Plantsville:* Mehmel & Sarvi..	13.25	1.91	10.75	10.00	2.48	5.00	68.93	2.68	2.50
9978	*Beacon Broiler Feed.* Beacon Milling Co., Cayuga, N. Y.	*Southbury:* H. R. Stone.....	11.56	6.26	17.38	16.00	5.33	6.00	55.14	4.33	4.00
9979	*Beacon Duck Fattener.* Beacon Milling Co., Cayuga, N. Y.	*Southbury:* H. R. Stone.....	11.10	8.15	17.88	14.00	4.75	5.50	53.57	4.55	5.00
9980	*Beacon Duck Growing Mash.* Beacon Milling Co., Cayuga, N. Y.....	*Southbury:* H. R. Stone.....	11.23	7.06	16.88	17.00	4.95	7.00	54.95	4.93	4.50
9981	*Beacon Developer Feed.* Beacon Milling Co., Cayuga, N. Y..	*Southbury:* H. R. Stone.....	13.18	1.75	10.50	10.00	2.00	5.00	69.36	3.21	2.50
8569	*Beacon Egg Mash with Buttermilk.* Beacon Milling Co., Cayuga, N. Y.....	*Shelton:* Shelton Feed Co.....	7.23	10.47	21.13	21.00	6.05	7.00	50.27	4.85	4.50

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1928—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*		%	%	%	%	%	%	%	%	%
	Poultry Feeds—Continued.										
226	*Beacon Fleshing Mash with Buttermilk.* Beacon Milling Co. Inc., Cayuga, N. Y.....	*Shelton:* Shelton Feed Co.....	9.35	9.53	15.75	14.00	5.90	6.00	54.19	5.28	4.50
8590	*Beacon Growing Mash.* Beacon Milling Co., Cayuga, N. Y..	*Shelton:* Shelton Feed Co.....	7.00	9.19	16.88	17.00	5.93	7.00	56.65	4.35	4.50
170	*Beacon Laying Mash.* Beacon Milling Co., Cayuga, N. Y..	*Danbury:* C. S. Barnum & Son	8.58	9.55	19.94	20.00	8.03	8.00	48.93	4.97	5.00
7945	*Beacon Special Scratch Grains.* Beacon Milling Co., Cayuga, N. Y.....	*Botsford:* G. T. Rasmussen...	13.15	1.25	9.13	9.00	1.70	3.50	71.92	2.85	3.00
150	*Beacon Scratch Grains.* Beacon Milling Co., Cayuga, N. Y..	*Danbury:* C. S. Barnum & Son	12.15	1.50	10.50	9.00	2.75	5.00	70.52	2.58	3.00
7942	*Beacon Starting Mash.* Beacon Milling Co., Cayuga, N. Y..	*Danbury:* C. S. Barnum & Son	10.40	7.86	15.63	14.00	4.75	6.00	56.81	4.55	4.50
8570	*Beacon Starting Mash.* Beacon Milling Co., Cayuga, N. Y..	*Shelton:* Shelton Feed Co.....	7.40	8.96	15.63	14.00	5.53	6.00	57.78	4.70	4.50

225	*Beacon Turkey Growing Feed.* Beacon Milling Co. Inc., Cayuga, N. Y.	*Shelton:* Shelton Feed Co	9.75	10.13	15.94	15.00	5.88	6.00	53.80	4.50	4.00
8557	*Cayuga Laying Mash with Buttermilk.* Beacon Milling Co., Cayuga, N. Y.	*Shelton:* Shelton Feed Co	8.60	7.88	20.56	20.00	6.63	7.00	51.33	5.00	4.00
224	*Cayuga Growing Mash.* Beacon Milling Co., Cayuga, N. Y.	*Botsford:* G. T. Rasmussen	9.58	9.74	17.06	15.00	6.30	7.00	52.39	4.93	4.00
7796	*Beers Scratch Feed.* I. W. Beers, Hamden, Conn	*Hamden:* I. W. Beers	12.65	1.58	10.19	9.00	3.20	4.00	68.92	3.46	3.00
8190	*Beers Scratch Feed.* I. W. Beers, Hamden, Conn	*Hamden:* I. W. Beers	8.73	1.77	10.13	9.00	4.36	4.00	71.73	3.28	3.00
7794	*Beers' Laying Mash.* I. W. Beers, Hamden, Conn	*Hamden:* I. W. Beers	11.10	7.14	18.50	22.00	7.26	7.00	51.05	4.95	5.00
8189	*Beers' Laying Mash.* I. W. Beers, Hamden, Conn	*Hamden:* I. W. Beers	8.88	9.03	20.25	20.00	6.40	7.00	49.81	5.63	5.00
8722	*Bristol Scratch Feed.* Bristol Grain & Supply Co., Bristol, Conn	*Bristol:* Bristol Grain & Supply Co	10.00	1.52	9.38	10.00	2.05	4.00	73.80	3.25	3.00
8723	*Bristol Laying Mash.* Bristol Grain & Supply Co., Bristol, Conn	*Bristol:* Bristol Grain & Supply Co	7.80	9.50	20.69	18.00	6.75	10.00	50.58	4.68	4.00
8611	*C. B. Mash.* C. Buckingham Co., Southport, Conn	*Southport:* C. Buckingham Co.	6.28	7.98	20.63	19.00	5.40	8.00	54.71	5.00	5.00
8596	*C. B. Growing Mash.* C. Buckingham Co., Southport, Conn.	*Southport:* C. Buckingham Co.	8.25	6.08	15.38	15.00	4.48	7.00	61.76	4.05	5.00
8597	*C. B. Scratch Feed.* C. Buckingham Co., Southport, Conn.	*Southport:* C. Buckingham Co.	9.05	1.63	10.44	11.19	3.30	3.80	73.03	2.55	2.76
308	*Egg-O-Dry Mash.* C. W. Campbell Co., Stonington, Conn.	*Groton:* C. W. Campbell Co.	9.58	10.53	20.19	18.00	7.90	12.00	46.67	5.13	2.00
309	*Egg-O-Scratch.* C. W. Campbell Co., Stonington, Conn.	*Stonington:* C. W. Campbell Co.	12.05	1.87	14.31	10.00	3.10	9.00	66.22	2.45	2.00
40	*Chapin Kernels Egg Mash.* Chapin & Co., Chicago, Ill.	*Collinsville:* Rourke-Robotham Co	8.25	10.42	19.63	18.00	3.18	5.50	54.64	3.88	4.50

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1928—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*		%	%	%	%	%	%	%	%	%
	Poultry Feeds—Continued.										
395	*Chapin Kernels Egg Mash.* Chapin & Co., Chicago, Ill..	*Danbury:* F. C. Benjamin....	8.35	10.18	19.44	18.00	3.08	5.50	53.85	5.10	4.50
35	*Chapin Kernels Grow-All.* Chapin & Co., Chicago, Ill..	*Collinsville:* Rourke-Robotham Co.....	8.70	8.01	16.31	16.00	2.73	5.50	60.87	3.38	4.50
294	*Chapin Kernels Grow-All.* Chapin & Co., Chicago, Ill..	*Riverton:* L. A. Coe.....	8.40	8.27	16.38	16.00	2.88	5.50	60.72	3.35	4.50
41	*Chapin Kernels Lay All.* Chapin & Co., Chicago, Ill.....	*Collinsville:* Rourke-Robotham Co.....	8.70	7.43	16.63	16.00	2.85	5.50	60.86	3.53	4.50
293	*Chapin Kernels Lay All.* Chapin & Co., Chicago, Ill.....	*Danbury:* F. C. Benjamin....	7.73	8.42	17.00	16.00	3.40	5.50	60.12	3.33	4.50
34	*Chapin Kernels Start All.* Chapin & Co., Chicago, Ill.....	*Collinsville:* Rourke-Robotham Co.....	9.02	7.66	15.94	15.00	2.35	4.50	60.13	4.90	4.00
32	*Unicorn Egg Mash with Buttermilk.* Chapin & Co., Chicago, Ill.....	*Collinsville:* Rourke-Robotham Co.....	8.93	11.88	21.38	20.00	4.53	7.00	48.58	4.70	4.50

31	*Unicorn Growing Mash with Buttermilk.* Chapin & Co., Chicago, Ill.	*Collinsville:* Rourke-Robotham Co.	9.30	11.78	18.00	18.00	3.53	7.00	53.14	4.25	4.50
33	*Unicorn Scratch Feed.* Chapin & Co., Chicago, Ill.	*Collinsville:* Rourke-Robotham Co.	11.15	1.84	10.69	10.00	3.28	5.00	69.39	3.65	2.50
8019	*Conkey's Buttermilk Meat Grain and Bone Growing Mash.* G. E. Conkey Co., Cleveland, Ohio	*Ansonia:* A. Hodos & Son.	10.40	11.33	20.56	18.00	4.90	5.00	47.71	5.10	4.00
9964	*Conkey's Chick Grains.* G. E. Conkey Co., Cleveland, Ohio	*Ansonia:* A. Hodos & Son.	11.84	1.74	11.94	11.00	1.83	2.00	68.85	3.80	2.50
8014	*Conkey's Gecco Egg Mash.* G. E. Conkey Co., Cleveland, Ohio	*Ansonia:* A. Hodos & Son.	10.20	9.25	20.06	20.00	4.48	7.00	49.91	6.10	5.00
9968	*Conkey's Gecco Egg Mash.* G. E. Conkey Co., Cleveland, Ohio	*Ansonia:* A. Hodos & Son.	10.05	10.51	21.19	20.00	4.68	7.00	48.21	5.36	5.00
9969	*Conkey's Geccofat with Buttermilk and Y-O.* G. E. Conkey Co., Cleveland, Ohio	*Ansonia:* A. Hodos & Son.	10.78	4.65	15.94	15.00	5.13	5.00	58.45	5.05	5.50
9966	*Conkey's Gecco Growing Mash.* G. E. Conkey Co., Cleveland, Ohio	*Ansonia:* A. Hodos & Son.	10.33	9.22	18.69	18.00	5.00	7.00	51.35	5.41	4.00
9967	*Conkey's Gecco Scratch Grains.* G. E. Conkey Co., Cleveland, Ohio	*Ansonia:* A. Hodos & Son.	12.95	1.67	10.13	10.50	2.88	3.00	69.30	3.07	2.50
9965	*Conkey's Growing Grains.* G. E. Conkey Co., Cleveland, Ohio	*Ansonia:* A. Hodos & Son.	12.51	1.67	11.75	11.00	1.88	2.50	68.31	3.88	2.50
9970	*Conkey's (The Original) Growing Mash with Buttermilk.* G. E. Conkey Co., Cleveland, Ohio	*Ansonia:* A. Hodos & Son.	10.43	11.52	21.88	18.00	4.15	6.00	46.58	5.44	4.00
9963	*Conkey's (The Original) Laying Mash with Buttermilk.* G. E. Conkey Co., Cleveland, Ohio	*Ansonia:* A. Hodos & Son.	10.33	9.87	22.94	20.00	4.75	6.00	46.28	5.83	5.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1928—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*		%	%	%	%	%	%	%	%	%
	Poultry Feeds—Continued.										
8018	*Conkey's Pigeon Feed (Breeders).* G. E. Conkey Co., Cleveland, Ohio	*Ansonia:* A. Hodos & Son	11.33	1.95	14.63	14.00	4.28	7.00	62.91	4.90	2.50
8708	*Conkey's (The Original) Starting Feed with Buttermilk.* G. E. Conkey Co., Cleveland, Ohio	*Middletown:* Meech & Stoddard Inc	9.33	5.43	14.00	14.00	3.60	4.00	63.04	4.60	3.00
8015	*Conkey's Scratch Grains.* G. E. Conkey Co., Cleveland, Ohio	*Ansonia:* A. Hodos & Son	12.25	1.38	10.13	9.75	2.35	3.00	71.09	2.80	1.75
8017	*Gecco Scratch Grains.* G. E. Conkey Co., Cleveland, Ohio	*Ansonia:* A. Hodos & Son	12.43	1.52	9.75	10.50	2.50	5.00	70.70	3.10	3.00
8020	*Superior Scratch.* G. E. Conkey Co., Cleveland, Ohio	*Ansonia:* A. Hodos & Son	12.50	1.30	9.25	9.00	2.08	3.00	72.02	2.85	2.50
8705	*Fortune Egg Mash with Dried Buttermilk.* The Coles Co., Middletown, Conn	*Middletown:* The Coles Co	8.70	10.20	20.31	17.00	5.03	9.00	50.41	5.35	3.50

7843	*Fortune Growing Feed.* The Coles Co., Middletown, Conn	*Middletown:* The Coles Co.	9.40	7.70	18.06	10.00	6.65	8.00	52.44	5.75	1.50
8704	*Fortune Growing Feed.* The Coles Co., Middletown, Conn	*Middletown:* The Coles Co.	8.65	9.85	18.00	10.00	5.00	8.00	54.25	4.25	1.50
8706	*Fortune Scratch Feed.* The Coles Co., Middletown, Conn	*Middletown:* The Coles Co.	10.95	1.55	10.00	10.00	2.88	5.00	71.34	3.28	2.50
7803	*C. A. Blue Seal Mash.* C. A. Cowles, Plantsville, Conn.	*Plantsville:* C. A. Cowles	10.13	11.48	17.25	18.00	5.83	6.00	49.86	5.45	4.00
8546	*C. A. Blue Seal Mash.* C. A. Cowles, Plantsville, Conn.	*Plantsville:* C. A. Cowles	7.75	8.57	17.88	18.00	5.95	6.00	54.77	5.08	4.00
8548	*Cowles Scratch Feed.* C. A. Cowles, Plantsville, Conn.	*Plantsville:* C. A. Cowles	9.45	1.30	9.75	10.00	2.48	5.00	74.72	2.30	1.50
9948	*Crosby's Egg Mash.* Crosby Milling Co., Brattleboro, Vt.	*Shelton:* Wolf Savitsky	10.99	6.49	19.75	20.00	5.60	7.00	52.17	5.00	4.00
262	*Crosby's Scratch Feed.* Crosby Milling Co., Brattleboro, Vt.	*Manchester:* O. E. Bailey	10.83	1.71	10.31	11.00	3.33	5.00	71.02	2.80	3.00
9925	*Davis Buttermilk Mash.* R. G. Davis & Sons, New Haven, Conn	*Milford:* Milford Grain Co.	10.33	8.34	18.50	18.00	6.33	7.00	51.40	5.10	5.00
9992	*Davis Scratch Feed.* R. G. Davis & Sons, New Haven, Conn	*Westville Branch:* R. G. Davis & Son	12.93	1.83	10.00	10.00	2.68	5.00	69.40	3.16	2.00
8811	*Delaware Chick Grains.* Delaware Mills, Deposit, N. Y.	*Southington:* Southington Lumber Co	9.60	1.08	10.00	10.00	1.18	3.00	76.09	2.05	3.00
8788	*Delaware Chick Starting Mash (with Dried Buttermilk).* Delaware Mills, Deposit, N. Y.	*Southington:* Southington Lumber Co	9.20	7.79	15.06	15.00	4.75	5.00	57.92	5.28	4.00
7805	*Delaware Growing Mash.* Delaware Mills, Deposit, N. Y.	*Southington:* Southington Lumber Co	10.85	6.33	16.81	17.00	5.28	6.00	55.16	5.57	5.00
7804	*Delaware Scratch Grains.* Delaware Mills, Deposit, N. Y.	*Southington:* Southington Lumber Co	12.95	1.54	9.94	10.00	3.03	5.00	69.37	3.17	2.50

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1928—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*		%	%	%	%	%	%	%	%	%
	Poultry Feeds—Continued.										
160	*Delaware Scratch Grains.* Delaware Mills, Deposit, N. Y.	*Winsted:* C. R. Hawley	11.78	1.70	10.81	10.00	2.98	5.00	70.29	2.44	2.50
164	*Indian Laying Mash (with Dried Buttermilk).* Delaware Mills, Deposit, N. Y.	*Winsted:* Chas. R. Hawley	9.98	7.33	18.19	18.00	5.28	7.00	53.90	5.32	4.00
8808	*Indian Scratch Grains.* Delaware Mills, Deposit, N. Y.	*East Bridgeport:* Kaplan Feed Co.	12.10	1.21	9.25	10.00	2.63	5.00	72.76	2.05	2.50
8720	*Devon Laying Mash.* Devon Coal & Ice Co., Devon, Conn.	*Devon:* Devon Coal & Ice Co.	8.40	8.82	18.88	18.00	7.83	7.00	51.57	4.50	4.50
8646	*Eastern States Egg Mash, Open Formula.* Eastern States Farmers' Exchange, Springfield, Mass.	*North Haven:* Ridgewood Farm	5.88	8.12	17.69	16.50	5.93	7.00	56.73	5.65	3.50
8649	*Eastern States Milk Egg Mash with Open Formula.* Eastern States Farmers' Exchange, Springfield, Mass.	*North Haven:* Ridgewood Farm	8.35	8.23	18.06	16.00	5.55	7.00	54.36	5.45	3.50

8647	*Eastern States Scratch Grains Open Formula.* (1927) Eastern States Farmers' Exchange, Springfield, Mass..	*North Haven:* Ridgewood Farm	9.50	1.44	10.88	9.50	2.08	3.00	73.05	3.05	2.50
8772	*Eastern States Scratch Grains Open Formula. (Old)* Eastern States Farmers' Exchange, Springfield, Mass..	*Watertown:* Watertown Co-op. Assoc	10.80	1.70	10.50	10.00	2.93	4.00	70.94	3.13	2.50
233	*Chixsaver.* Elmore Milling Co., Oneonta, N. Y.	*Hazardville:* A. D. Bridges' Sons	9.63	9.91	15.81	18.00	4.05	9.00	55.93	4.67	4.00
9947	*Elmore Egg Mash.* Elmore Milling Co., Oneonta, N. Y.	*Shelton:* Wolf Savitsky	10.48	8.56	21.69	18.00	5.25	8.00	47.88	6.14	4.00
7820	*Elmore Growing Mash.* Elmore Milling Co., Oneonta, N. Y.	*Hazardville:* A. D. Bridges' Sons	11.15	8.48	19.13	17.00	5.65	8.00	50.45	5.14	4.00
9951	*Elmore Growing Mash.* Elmore Milling Co., Oneonta, N. Y.	*Shelton:* Wolf Savitsky	10.30	9.66	19.00	17.00	5.40	8.00	50.21	5.43	4.00
163	*Elmore (Storrs Formula) Laying Mash.* Elmore Milling Co., Oneonta, N. Y.	*Newtown:* R. H. Holcomb & Co.	9.63	7.77	18.31	18.00	6.70	7.00	52.09	5.50	4.00
8662	*Eshelman's Baby Chick Starter.* John W. Eshelman & Sons, Lancaster, Pa.	*Wallingford:* A. E. Hall	6.80	6.17	16.06	14.00	4.65	6.00	61.47	4.85	4.00
8663	*Eshelman's Chick Feed.* John W. Eshelman & Sons, Lancaster, Pa.	*Wallingford:* A. E. Hall	9.50	1.88	11.25	10.00	1.80	3.00	71.32	4.25	3.00
22	*Eshelman's Fattening Mash.* John W. Eshelman & Sons, Lancaster, Pa.	*New Haven:* Moran-Patton Co.	10.30	6.39	17.63	13.00	4.18	6.00	57.50	4.00	4.00
8630	*Eshelman Growing Mash.* John W. Eshelman & Sons, Lancaster, Pa.	*Norwalk:* Frank Libner & Sons	6.73	6.23	17.13	16.00	5.28	7.00	59.66	4.97	4.00
8633	*Eshelman's Laying Mash.* John W. Eshelman & Sons, Lancaster, Pa.	*Norwalk:* Frank Libner & Sons	6.15	8.68	20.50	20.00	5.23	7.00	53.74	5.70	5.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1928—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*		%	%	%	%	%	%	%	%	%
	Poultry Feeds—Continued.										
8188	*Eshelman's Scratch Feed.* John W. Eshelman & Sons, Lancaster, Pa.	*Hamden:* I. W. Beers	7.97	1.38	10.13	10.00	2.43	4.00	75.40	2.69	2.50
8555	*Imperial Scratch Feed.* John W. Eshelman & Sons, Lancaster, Pa.	*Plainville:* W. S. Eaton	8.95	1.80	10.13	9.00	2.30	4.00	73.89	2.93	2.50
9929	*Lancaster Scratch Feed.* John W. Eshelman & Sons, Lancaster, Pa.	*Stratford:* Farmers' Flour & Grain Co.	12.10	1.71	10.75	10.00	3.00	4.00	69.79	2.65	2.50
108	*Flory's Chick Starter.* Flory Milling Co., Inc., Bangor, Pa.	*Bloomfield:* Bloomfield Farmers' Exchange	10.45	7.22	14.63	13.00	3.95	4.50	59.41	4.34	3.00
44	*Flory's Egg Mash.* Flory Milling Co., Inc., Bangor, Pa.	*Bloomfield:* Bloomfield Farmers' Exchange	9.50	9.41	19.56	20.00	8.20	8.00	48.13	5.20	4.50
45	*Flory's Growing Mash.* Flory Milling Co. Inc., Bangor Pa.	*Bloomfield:* Bloomfield Farmers' Exchange	9.90	8.12	14.69	17.00	4.73	7.00	57.46	5.10	4.50
372	*Flory's Growing Mash.* Flory Milling Co. Inc., Bangor, Pa.	*Bloomfield:* Bloomfield Farmers' Exchange	10.05	8.01	15.19	17.00	4.45	7.00	57.45	4.85	4.50

7812	*Flory's Intermediate Chick Feed.* Flory Milling Co., Inc., Bangor, Pa.	*Bloomfield:* Bloomfield Farmers' Exchange	12.61	1.34	9.06	9.00	1.80	5.00	72.01	3.18	2.50
109	*Flory's Intermediate Chick Feed.* Flory Milling Co., Inc., Bangor, Pa.	*Bloomfield:* Bloomfield Farmers' Exchange	12.75	1.41	9.75	9.00	2.70	5.00	71.30	2.09	2.50
43	*Sunray Scratch Feed.* Flory Milling Co. Inc., Bangor, Pa.	*Bloomfield:* Bloomfield Farmers' Exchange	12.55	1.66	10.00	9.00	2.88	5.00	70.26	2.65	2.50
8801	*R-Own Laying Mash.* A. W. Forbes, East Haven, Conn..	*East Haven:* A. W. Forbes....	6.90	9.64	20.88	20.00	5.48	6.00	51.52	5.58	5.00
8787	*R-Own Scratch Feed.* A. W. Forbes, East Haven, Conn..	*East Haven:* A. W. Forbes....	9.50	1.69	10.38	10.00	2.70	5.00	72.48	3.25	3.00
7934	*Grandin's Laying Mash with Buttermilk.* D. H. Grandin Milling Co., Jamestown, N. Y.	*Falls Village:* H. E. Dean....	9.18	13.51	21.31	20.00	6.65	8.00	44.80	4.55	4.00
7935	*Grandin's Screened Scratch Feed.* D. H. Grandin Milling Co., Jamestown, N. Y.....	*Falls Village:* H. E. Dean....	12.00	1.58	10.63	10.00	2.90	5.00	70.09	2.80	2.50
8182	*Red Comb Chick Starter.* Hales & Hunter Co., Chicago, Ill.	*Highwood:* T. C. Hadden & Co.	7.07	9.03	14.25	14.00	3.58	5.00	61.23	4.84	4.00
8181	*Red Comb Egg Mash.* Hales & Hunter Co., Chicago, Ill....	*Highwood:* T. C. Hadden & Co.	7.55	10.50	15.69	15.00	5.15	6.00	57.06	4.05	4.00
8754	*Red Comb Growing Mash.* Hales & Hunter Co., Chicago, Ill.	*New Britain:* Stanley Svea Grain Co	8.95	9.27	16.63	14.00	4.98	6.00	55.57	4.60	4.00
8185	*Red Comb Scratch Feed, No Grit.* Hales & Hunter Co., Chicago, Ill.....	*Highwood:* T. C. Hadden & Co.	9.25	1.76	10.63	10.00	2.60	5.00	72.58	3.18	2.50
8760	*Algrane Steam Cooked Chick Feed.* Hecker H. O. Co., Buffalo, N. Y.....	*South Norwalk:* Roodner Feed Co.....	8.45	1.63	12.50	12.00	1.33	4.00	72.94	3.15	3.00
7824	*Hudson's Developing Mash.* L. W. Hudson, Windsor, Conn.	*Windsor:* L. W. Hudson.....	9.85	8.29	18.00	17.00	5.03	5.40	53.87	4.96	6.00
8806	*Hudson's Developing Mash.* L. W. Hudson, Windsor, Conn.	*Windsor:* L. W. Hudson.....	7.40	7.95	18.00	17.00	5.30	5.40	56.10	5.25	6.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1928—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*		%	%	%	%	%	%	%	%	
	Poultry Feeds—Continued.										
7823	*Hudson's Laying Mash.* L. W. Hudson, Windsor, Conn....	*Windsor:* L. W. Hudson.....	10.10	9.38	17.38	19.00	6.48	5.00	51.61	5.05	6.00
9791	*Blue Top Chick Feed, No Grit.* Chas. A. Krause Milling Co., Milwaukee, Wis.....	*Thomaston:* I. Levy.....	12.05	1.23	9.88	10.00	1.68	5.00	73.31	1.85	2.50
8813	*Blue Top Egg Mash.* Chas. A. Krause Milling Co., Milwaukee, Wis.....	*Thomaston:* I. Levy.....	6.05	7.67	20.38	20.00	6.43	7.50	54.09	5.38	5.00
8814	*Blue Top Scratch Feed, No Grit.* Chas. A. Krause Milling Co., Milwaukee, Wis...	*Thomaston:* I. Levy.....	10.15	1.47	10.38	10.00	2.45	5.00	72.70	2.85	2.50
7840	*Dry Mash.* S. F. Labieniec, Kensington, Conn.....	*Kensington:* S. F. Labieniec..	9.32	8.18	18.75	19.00	7.73	9.00	50.02	6.00	5.00
8675	*Dry Mash.* S. F. Labieniec, Kensington, Conn.....	*Kensington:* S. F. Labieniec..	7.10	9.12	19.25	19.00	7.80	8.00	51.38	5.35	5.00
8757	*Larro Chick Starter.* Larrowe Milling Co., Detroit, Mich..	*South Norwalk:* Roodner Feed Co.....	10.25	5.80	15.38	14.00	4.33	6.50	59.19	5.05	4.50

8551	*Larro Egg Mash.* Larrowe Milling Co., Detroit, Mich..	*Plainville:* F. B. Newton.....	7.40	11.56	19.94	19.00	6.38	8.00	49.02	5.70	5.00
48	*Larro Growing Mash.* Larrowe Milling Co., Detroit, Mich..	*Collinsville:* Lawton Miner Co.	9.73	8.25	16.88	16.00	5.80	6.50	54.77	4.57	5.00
7846	*Larro Scratch Grains.* Larrowe Milling Co., Detroit, Mich..	*Branford:* S. V. Osborn, Est...	11.60	1.62	11.00	10.00	2.88	4.00	70.05	2.85	2.50
8550	*Larro Scratch Grains.* Larrowe Milling Co., Detroit, Mich..	*Plainville:* F. B. Newton.....	9.10	1.64	10.88	10.00	2.90	4.00	72.30	3.18	2.50
8208	*Homestead Dry Mash.* C. W. Lines Co., New Britain, Conn.....	*New Britain:* C. W. Lines Co.	7.70	10.04	20.38	18.00	6.18	7.00	50.27	5.43	4.00
8206	*Homestead Scratch Feed.* C. W. Lines Co., New Britain, Conn.....	*New Britain:* C. W. Lines Co.	10.75	1.26	9.50	9.00	2.03	5.00	74.26	2.20	2.50
8209	*Mill Pride Fancy Scratch Feed.* C. W. Lines Co., New Britain, Conn.....	*New Britain:* C. W. Lines Co.	9.93	1.36	10.06	10.00	2.77	5.00	73.20	2.68	3.00
8205	*Mill Pride Milk Mash.* C. W. Lines Co., New Britain, Conn.....	*New Britain:* C. W. Lines Co.	7.30	11.64	18.88	18.00	6.98	7.50	50.10	5.10	5.00
7928	*Common Sense Laying Mash.* Litchfield Co-op. Assoc., Torrington, Conn.....	*Torrington:* Litchfield Co-op. Assoc.....	10.25	8.40	15.81	15.00	7.48	8.00	53.11	4.95	4.00
165	*Square Deal Buttermilk Laying Mash.* Long Hill Feed Store, Long Hill, Conn.....	*Long Hill:* Long Hill Feed Store	8.58	14.46	16.69	20.00	6.65	7.00	48.13	5.49	5.00
244	*Buttermilk Mash.* E. Manchester & Sons, Winsted, Conn..	*Winsted:* E. Manchester & Sons	7.85	16.38	15.00	20.00	6.40	6.00	49.14	5.23	4.00
241	*Red Star Egg Mash.* E. Manchester & Sons, Winsted, Conn.....	*Winsted:* E. Manchester & Sons	9.13	11.80	18.75	18.00	5.83	8.00	49.04	5.45	4.00
240	*Red Star Scratch Feed.* E. Manchester & Sons, Winsted, Conn.....	*Winsted:* E. Manchester & Sons	11.68	1.96	11.38	9.00	3.10	7.00	69.65	2.23	3.50

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1928—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*		%	%	%	%	%	%	%	%	
	Poultry Feeds—Continued.										
249	*Bull Brand Chick Feed.* Maritime Milling Co., Buffalo, N. Y.	*Riverton:* L. A. Coe	12.40	1.30	10.38	11.00	1.70	4.00	72.52	1.70	2.50
248	*Bull Brand Chick Starter (with Dried Buttermilk).* Maritime Milling Co., Buffalo, N. Y.	*Riverton:* L. A. Coe	9.60	7.94	15.31	12.00	4.23	4.00	58.49	4.43	4.00
245	*Bull Brand Growing Mash (with Dried Buttermilk).* Maritime Milling Co., Buffalo, N. Y.	*Riverton:* L. A. Coe	9.65	9.81	18.06	18.00	5.35	7.00	51.88	5.25	5.00
167	*Bull Brand Laying Mash (with Dried Buttermilk).* Maritime Milling Co., Buffalo, N. Y.	*New Milford:* Geo. E. Ackley & Co.	9.00	10.03	20.75	20.00	7.65	8.00	47.07	5.50	5.00
177	*Bull Brand Scratch Feed.* Maritime Milling Co., Buffalo, N. Y.	*New Milford:* Geo. E. Ackley & Co.	11.88	1.94	11.13	10.00	4.33	4.00	67.52	3.20	2.50

7938	*Red E Lay Laying Mash.* Maritime Milling Co., Buffalo, N. Y.	*New Milford:* Geo. E. Ackley & Co.	9.66	9.18	19.25	18.00	6.30	9.00	50.41	5.20	5.00
168	*Red-E-Mixt Egg Mash.* Maritime Milling Co., Buffalo, N. Y.	*New Milford:* Geo. E. Ackley & Co.	9.13	10.16	19.50	18.00	6.53	9.00	48.95	5.73	5.00
246	*Jersey Dry Mash (with Dried Buttermilk).* Maritime Milling Co., Buffalo, N. Y.	*Riverton:* L. A. Coe	8.78	8.30	19.81	18.00	6.50	9.00	50.56	6.05	5.00
8493	*Red Wing Scratch Feed.* Meech & Stoddard, Inc., Middletown, Conn.	*Plantsville:* Mehmel & Sarvi.	12.58	1.42	9.38	10.00	2.60	5.00	71.34	2.68	3.00
8763	*Red Wing Special Buttermilk Chick Starter.* Meech & Stoddard, Inc., Middletown, Conn.	*Middletown:* Meech & Stoddard, Inc.	8.85	12.76	16.13	13.00	5.65	5.00	51.96	4.65	4.00
8762	*Red Wing Special Buttermilk Growing Feed.* Meech & Stoddard, Inc., Middletown, Conn.	*Middletown:* Meech & Stoddard, Inc.	8.85	13.64	17.19	17.00	5.93	8.00	49.69	4.70	5.50
8494	*Red Wing Special Buttermilk Laying Mash.* Meech & Stoddard, Inc., Middletown, Conn.	*Plantsville:* Mehmel & Sarvi.	8.88	8.17	19.44	17.00	6.28	8.00	51.53	5.70	5.50
8764	*Red Wing Special Chick Feed.* Meech & Stoddard, Inc., Middletown, Conn.	*Middletown:* Meech & Stoddard, Inc.	12.55	1.36	10.81	10.00	1.48	5.00	71.10	2.70	3.00
8765	*Red Wing Special Intermediate Chick Feed.* Meech & Stoddard, Inc., Middletown, Conn.	*Middletown:* Meech & Stoddard, Inc.	11.63	1.55	11.25	10.00	2.56	5.00	69.83	3.18	3.00
123	*Moon's Developing Grains.* Geo. Q. Moon & Co., Binghamton, N. Y.	*Manchester:* I. P. Campbell...	11.53	1.87	11.63	10.00	1.98	5.00	69.54	3.45	2.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1928—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*		%	%	%	%	%	%	%	%	%
	Poultry Feeds—Continued.										
287	*Moon's Growing Mash.* Geo. Q. Moon & Co., Binghamton, N. Y.	*Manchester:* I. P. Campbell...	8.28	11.60	19.50	17.00	5.80	7.00	49.44	5.38	4.00
121	*Moon's Laying Mash with Dried Buttermilk.* Geo. Q. Moon & Co., Binghamton, N. Y.	*Manchester:* I. P. Campbell...	9.20	9.42	20.00	20.00	6.15	9.00	49.65	5.58	4.00
124	*Moon's Scratch Feed.* Geo. Q. Moon & Co., Binghamton, N. Y.	*Manchester:* I. P. Campbell...	12.50	1.42	9.63	10.00	3.03	5.00	71.22	2.20	2.00
18	*C. B. Mash.* Moran-Patton Co., New Haven, Conn.	*New Haven:* Moran-Patton Co.	10.45	8.21	18.88	18.00	7.33	7.00	49.93	5.20	4.00
8317	*Old Mill Buttermilk Laying Mash.* Fred C. Morse, Guilford, Conn.	*Guilford:* Fred C. Morse.....	6.05	8.40	20.13	20.00	7.45	8.00	51.27	6.70	5.00
8318	*Old Mill Laying Mash.* Fred C. Morse, Guilford, Conn.	*Guilford:* Fred C. Morse.....	5.90	8.80	20.63	20.00	7.50	8.00	51.92	5.25	5.00

128	*Old Mill Growing Mash with Milk.* Fred C. Morse, Guilford, Conn	*Guilford:* Fred C. Morse	9.85	6.49	16.25	16.00	6.18	7.00	56.30	4.93	5.00
7847	*Old Mill Scratch Feed.* Fred C. Morse, Guilford, Conn	*Guilford:* Fred C. Morse	11.36	1.56	10.44	10.00	2.63	4.00	70.63	3.38	3.00
7951	*Mystic Laying Mash.* Newman Bros. Grain Co., Rochester, N. Y	*Naugatuck:* Davis Feed Store	10.50	8.04	19.25	19.00	7.25	10.00	48.96	6.00	4.00
8668	*Marathon Laying Mash with Buttermilk.* Nowak Milling Corp., Hammond, Ind	*Meriden:* Reliable Grain & Feed Co	7.60	10.59	20.56	20.00	6.45	9.00	49.80	5.00	4.50
23	*Aunt Mary's Egg Mash with Dried Buttermilk.* Ontario Milling Co., Oswego, N. Y.	*Meriden:* H. Grulich	9.68	9.88	20.00	19.00	5.50	8.50	49.36	5.58	4.00
8809	*Aunt Mary's Scratch Feed.* Ontario Milling Co., Oswego, N. Y	*Meriden:* H. Grulich	10.55	1.67	10.38	10.00	2.93	5.00	70.82	3.65	2.50
8666	*Oswego Egg Mash with Meat and Fish.* Ontario Milling Co., Oswego, N. Y	*Meriden:* Reliable Grain & Feed Co	7.75	9.87	19.00	18.00	6.13	8.50	53.07	4.18	4.00
8810	*Oswego Scratch Feed.* Ontario Milling Co., Oswego, N. Y.	*Meriden:* H. Grulich	10.00	1.59	10.00	10.00	2.93	5.00	71.58	3.90	2.50
8314	*Osborn's Mash.* S. V. Osborn, Est., Branford, Conn	*Branford:* S. V. Osborn, Est.	7.00	4.35	14.13	12.00	6.96	8.00	63.95	3.61	3.00
8313	*Osborn's Scratch.* S. V. Osborn, Est., Branford, Conn	*Branford:* S. V. Osborn, Est.	7.45	1.56	10.50	10.00	2.33	5.00	75.51	2.65	2.00
147	*Bidwell Dry Mash.* Park & Pollard Co., Buffalo, N. Y	*Bridgeport:* Samp Mortar Mills	9.20	11.46	23.25	18.00	5.53	10.00	46.88	3.68	1.50
8567	*Bidwell Scratch Feed.* Park & Pollard Co., Buffalo, N. Y.	*Derby:* Peterson-Hendee Co	8.73	1.48	10.25	10.00	2.65	5.00	73.64	3.25	1.50
53	*Bonnie Booster.* Park & Pollard Co., Buffalo, N. Y	*Bristol:* Bristol Grain & Supply Co	10.03	4.34	15.25	12.00	4.18	5.00	63.10	3.10	3.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1928—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*		%	%	%	%	%	%	%	%	%
	Poultry Feeds—Continued.										
251	*Growing Feed.* Park & Pollard Co., Buffalo, N. Y.....	*New Hartford:* G. W. Case Inc.	10.15	7.99	15.19	14.00	5.68	8.00	57.66	3.33	1.50
8752	*Intermediate Chick Feed.* Park & Pollard Co., Buffalo, N. Y.	*Plainville:* F. B. Newton.....	12.40	1.40	10.06	10.00	2.08	5.00	71.03	3.03	1.50
8478	*Lay or Bust Dry Mash.* Park & Pollard Co., Buffalo, N. Y..	*West Cheshire:* Cheshire Grain & Coal.....	7.30	9.26	20.81	18.00	5.68	10.00	53.05	3.90	1.50
8481	*Red Ribbon Scratch Feed.* Park & Pollard Co., Buffalo, N. Y.	*Plainville:* F. B. Newton.....	8.20	1.43	10.50	10.00	2.52	5.00	74.65	2.70	1.50
11	*Platco Laying Mash.* Frank S. Platt Co., New Haven, Conn.	*New Haven:* Frank S. Platt Co.	10.35	11.93	21.31	20.00	5.50	7.00	45.88	5.03	5.50
321	*Platco Laying Mash.* Frank S. Platt Co., New Haven, Conn.	*New Haven:* Frank S. Platt Co.	9.08	11.99	21.38	20.00	5.98	7.00	45.89	5.68	5.50
8021	*Platco Perfection Grain Mixture.* Frank S. Platt Co., New Haven, Conn.....	*New Haven:* Frank S. Platt Co.	11.30	1.90	11.19	10.50	4.00	4.50	67.56	4.05	3.00

354	*Platco Perfection Grain Mixture.* Frank S. Platt Co., New Haven, Conn.	*New Haven:* Frank S. Platt Co.	11.30	1.44	10.31	10.50	2.98	4.50	70.87	3.10	3.50
8807	*Puritan Scratch Feed.* W. N. Potter & Sons, Springfield, Mass.	*Windsor:* L. W. Hudson	10.15	1.66	10.13	10.00	3.65	2.50	71.33	3.08	3.00
252	*Puritan Scratch Feed.* W. N. Potter & Sons, Springfield, Mass.	*Bloomfield:* Bloomfield Farmers' Exchange	11.65	1.72	10.63	10.00	3.70	2.50	69.30	3.00	3.00
54	*Pratt's Baby Chick Food with Buttermilk.* Pratt Food Co., Buffalo, N. Y.	*Bristol:* Bristol Grain & Supply Co.	9.14	9.21	14.38	13.00	3.75	3.80	59.05	4.47	3.50
7806	*Pratt's Circle A Chick Scratch.* Pratt Food Co., Hammond, Ind.	*Bristol:* Bristol Grain & Supply Co.	12.16	1.04	10.50	10.00	1.28	5.00	71.97	3.05	2.50
8724	*Pratt's Circle A Large Scratch Feed.* Pratt Food Co., Hammond, Ind.	*Bristol:* Bristol Grain & Supply Co.	9.95	1.35	10.00	10.00	3.13	5.00	73.09	2.48	2.50
8632	*Pratt's Supreme Chick Scratch Feed.* Pratt Food Co., Hammond, Ind.	*Norwalk:* Frank Libner & Sons	5.80	2.03	13.25	10.00	1.60	5.00	74.82	2.50	2.00
27	*Pratt's Supreme Growing Mash with Buttermilk.* Pratt Food Co., Hammond, Ind.	*New Britain:* S. P. Strople	9.20	10.61	17.63	17.50	4.90	7.00	51.96	5.70	4.50
8635	*Pratt's Victory Chick Scratch Feed.* Pratt Food Co., Hammond, Ind.	*Norwalk:* Frank Libner & Sons	6.15	1.15	10.75	10.00	1.20	5.00	78.95	1.80	2.00
8751	*Pratt's Victory Laying Mash with Buttermilk.* Pratt Food Co., Hammond, Ind.	*Plainville:* F. B. Newton	9.45	10.99	20.13	20.00	6.63	8.00	46.70	6.10	4.00
253	*Egg-Em-On Laying Mash.* H. C. Puffer Co., Springfield, Mass.	*Suffield:* Spencer Bros.	9.70	9.48	21.63	20.00	7.60	8.00	47.16	4.43	4.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1928—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*		%	%	%	%	%	%	%	%	%
	Poultry Feeds—Continued.										
322	*Egg-Em-On -Scratch.* H. C. Puffer Co., Springfield, Mass.	*Manchester:* Little & McKinney	11.98	1.72	10.13	10.00	2.85	5.00	70.64	2.68	1.50
9996	*Quaker Ful-O-Pep Coarse Chick Feed.* Quaker Oats Company, Chicago, Ill	*Hamden:* I. W. Beers	13.18	1.49	10.25	10.00	2.43	2.50	69.75	2.90	2.00
8186	*Quaker Ful-O-Pep Egg Mash.* Quaker Oats Co., Chicago, Ill	*Hamden:* I. W. Beers	5.85	11.42	19.50	20.00	6.13	8.00	51.22	5.88	4.00
9997	*Quaker Ful-O-Pep Growing Mash.* Quaker Oats Co., Chicago, Ill	*Hamden:* I. W. Beers	9.00	8.70	18.63	19.00	4.60	6.00	53.12	5.95	5.00
8187	*Quaker Ful-O-Pep Scratch Grains.* Quaker Oats Co., Chicago, Ill	*Hamden:* I. W. Beers	7.25	1.91	10.63	9.00	2.73	3.00	74.30	3.18	2.00
8634	*Schumacher's Little Chick Feed, No Grit.* Quaker Oats Co., Chicago, Ill	*Norwalk:* Frank Libner & Sons	6.75	1.33	10.63	10.00	2.05	2.00	76.69	2.55	2.00

9930	*Schumacher's Scratch Grains, No Grit.* Quaker Oats Co., Chicago, Ill.	*Stratford:* Farmers' Flour & Grain Co.	11.80	1.73	11.25	10.00	3.15	3.50	69.47	2.60	2.00
7918	*Fine Ground Green Poultry Alfalfa Meal.* Ralston Purina Mills, St. Louis, Mo.	*Westerly:* C. W. Campbell Co.	8.61	10.04	18.69	17.00	22.85	25.00	37.46	2.35	1.60
8702	*Purina Baby Chick Chow Feed.* Ralston Purina Co., St. Louis, Mo.	*Middletown:* The Coles Company	10.25	1.81	11.50	10.00	2.20	4.00	71.34	2.90	2.00
8703	*Purina Chicken Chowder Feed.* Ralston Purina Co., St. Louis, Mo.	*Middletown:* The Coles Company	9.05	8.26	20.31	19.00	7.35	8.00	50.68	4.35	4.00
190	*Purina Chicken Fat Chow Feed.* Ralston Purina Co., St. Louis, Mo.	*Stamford:* Clapboard Hill Feed Co.	9.33	4.23	15.88	15.50	3.65	4.50	62.78	4.13	4.00
14	*Purina Chicken Fatena.* Ralston Purina Co., St. Louis, Mo.	*New Haven:* Moran-Patton Co.	10.43	3.90	14.13	12.00	5.45	6.60	61.81	4.28	4.00
12	*Purina Chick Growene Feed.* Ralston Purina Co., St. Louis, Mo.	*New Haven:* Moran-Patton Co.	9.61	7.91	18.19	16.80	5.73	7.00	52.55	6.01	4.00
189	*Purina Chick Startena Feed.* Ralston Purina Co., St. Louis, Mo.	*Stamford:* Clapboard Hill Feed Co.	8.83	8.00	18.25	17.00	6.03	7.00	52.56	6.33	4.00
213	*Purina Grainola Feed.* Ralston Purina Co., St. Louis, Mo.	*Stamford:* Clapboard Hill Feed Co.	12.15	3.69	9.00	8.00	8.83	15.00	63.75	2.58	2.00
13	*Purina Hen Chow Feed.* Ralston Purina Co., St. Louis, Mo.	*New Haven:* Moran-Patton Co.	12.38	1.78	10.75	10.00	2.55	4.00	69.72	2.82	2.50
129	*Purina Lamb Chow containing Charcoal.* Ralston Purina Co., St. Louis, Mo.	*Middletown:* Coles Company.	11.10	5.07	16.75	14.00	9.53	12.00	54.12	3.43	3.00
363	*Winner Scratch Feed.* Ralston Purina Co., St. Louis, Mo.	*Norwich:* Norwich Grain Co.	11.90	1.70	10.88	10.00	2.75	5.00	70.12	2.65	2.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1928—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
			%	%	%	%	%	%	%	%	%
	PROPRIETARY MIXED FEEDS—*Continued.*										
	Poultry Feeds—Continued.										
393	*Diamond Chick Feed.* Rockville Grain & Coal Co., Rockville, Conn.	*Manchester:* Manchester Grain & Coal	11.28	1.89	10.88	10.00	1.60	3.00	69.95	4.40	3.00
391	*Diamond Laying Mash.* Rockville Grain & Coal Co., Rockville, Conn.	*Manchester:* Manchester Grain & Coal	8.55	8.63	21.06	20.00	5.53	7.00	50.00	6.23	5.00
390	*Diamond Scratch Feed.* Rockville Grain & Coal Co., Rockville, Conn.	*Manchester:* Manchester Grain & Coal	11.40	1.44	10.50	10.00	2.45	4.00	72.03	2.18	2.50
8289	*Hubbard's Egg Producer.* Fred H. Rolf, Guilford, Conn.	*Guilford:* Fred H. Rolf	6.40	11.54	22.75	.....	5.35	.....	48.38	5.58	.....
127	*Rolf's Chic Grains.* Fred H. Rolf, Guilford, Conn.	*Guilford:* Fred H. Rolf	11.93	1.41	9.63	10.00	1.55	4.00	72.25	3.23	4.00
8287	*Rolf's Chick Mash.* Fred H. Rolf, Guilford, Conn.	*Guilford:* Fred H. Rolf	6.70	9.41	18.50	.....	4.95	.....	55.11	5.33	.....
8288	*Rolf's Scratch Grains.* Fred H. Rolf, Guilford, Conn.	*Guilford:* Fred H. Rolf	7.70	2.05	9.69	.....	2.78	.....	74.45	3.33	.....

9788	*See More Egg Mash with Buttermilk.* Seymour Grain & Coal Co., Seymour, Conn	*Seymour:* Seymour Grain & Coal Co	9.50	9.77	20.13	18.00	5.95	7.00	50.12	4.53	4.50
9977	*See More Egg Scratch Feed.* Seymour Grain & Coal Co., Seymour, Conn	*Seymour:* Seymour Grain & Coal Co	12.95	1.52	10.13	10.00	2.88	6.00	69.77	2.75	3.00
8586	*Nelson's Laying Mash.* Shelton Feed Co., Shelton, Conn.	*Shelton:* Shelton Feed Co	6.85	7.48	18.00	16.00	6.05	8.00	56.29	5.33	4.00
8587	*Nelson's Mixed Chicken Feed.* Shelton Feed Co., Shelton, Conn	*Shelton:* Shelton Feed Co	9.00	1.47	10.00	10.00	2.53	5.00	73.77	3.23	1.50
55	*Mill Streams "Fortune Hunter" Scratch Grains.* Winchell Smith, Farmington, Conn	*Farmington:* Winchell Smith	11.95	1.87	11.00	10.00	3.65	3.00	67.96	3.57	2.50
100	*Mill Streams "Lightnin" Laying Mash.* Winchell Smith, Farmington, Conn	*Farmington:* Winchell Smith	10.38	9.52	21.13	16.00	5.60	8.00	48.92	4.45	3.00
7906	*King Growing Feed containing Dried Buttermilk and Beef Scraps.* St. Albans Grain Co., St. Albans, Vt	*Willimantic:* Willimantic Grain Co	10.75	8.79	16.19	15.00	4.88	5.00	53.74	5.65	4.00
329	*King Mash Feed containing Buttermilk, Fish and Meat Scraps.* St. Albans Grain Co., St. Albans, Vt	*Willimantic:* Willimantic Grain Co	9.43	9.23	20.81	19.50	6.35	7.50	49.53	4.65	4.00
328	*King Scratch Feed.* St. Albans Grain Co., St. Albans, Vt	*Willimantic:* Willimantic Grain Co	11.95	2.12	11.25	10.00	3.05	5.50	69.00	2.63	2.50
8664	*Paragon Scratch Feed.* St. Albans Grain Co., St. Albans, Vt	*Meriden:* West End Poultry Supply	10.80	1.45	10.00	10.00	2.40	5.00	72.65	2.70	2.50
8615	*Wirthmore All Grain Chick Feed (Fine Chick Scratch).* St. Albans Grain Co., St. Albans, Vt	*Southport:* C. Buckingham	7.45	1.39	10.75	11.00	1.63	3.50	74.58	4.20	2.50

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1928—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*		%	%	%	%	%	%	%	%	%
	Poultry Feeds—Continued.										
8613	*Wirthmore Buttermilk Baby Chick Food.* St. Albans Grain Co., St. Albans, Vt..	*Southport:* C. Buckingham....	7.00	8.41	16.88	17.00	3.62	5.00	60.11	3.98	4.00
137	*Wirthmore Certified Scratch Feed.* St. Albans Grain Co., St. Albans, Vt.....	*Branford:* S. V. Osborn Est...	12.38	1.96	10.75	10.00	2.65	5.00	69.01	3.25	2.50
8768	*Wirthmore Growing Feed with Dried Buttermilk and Beef Scraps.* St. Albans Grain Co., St. Albans, Vt.....	*Plainville:* F. B. Newton.....	9.65	7.92	16.63	15.00	5.13	5.00	55.34	5.33	4.50
9982	*Wirthmore Intermediate Chick Feed (Coarse Chick Scratch).* St. Albans Grain Co., St. Albans, Vt.....	*Southbury:* H. R. Stone.....	13.18	1.36	10.56	10.00	1.68	3.50	70.52	2.70	2.50
8643	*Wirthmore Laying Mash with Buttermilk.* St. Albans Grain Co., St. Albans, Vt.....	*North Haven:* W. L. Thorpe..	6.75	10.57	20.63	20.00	5.38	7.00	50.79	5.88	4.00

25	*Wirthmore Poultry Greens* St. Albans Grain Co., St. Albans, Vt.	*Kensington:* S. F. Labieniec..	8.00	10.65	17.13	20.00	21.18	18.00	40.79	2.25	2.00
332	*Wirthmore Poultry Greens.* St. Albans Grain Co., St. Albans, Vt.	*Groton:* C. W. Campbell Co...	8.25	9.81	16.50	20.00	24.15	18.00	39.41	1.88	2.00
8642	*Wirthmore Scratch Feed.* St. Albans Grain Co., St. Albans, Vt.	*North Haven:* W. L. Thorpe..	8.45	1.60	10.50	10.00	2.58	5.00	73.97	2.90	2.50
8679	*Blueridge Egg Mash.* D. A. Stickell & Sons, Hagerstown, Md.	*New Britain:* Hugh Reynolds Grain Co.	6.83	7.83	19.75	20.00	4.58	6.00	54.96	6.05	5.00
8680	*Victor Scratch Grains.* D. A. Stickell & Son, Hagerstown, Md.	*New Britain:* Hugh Reynolds Grain Co.	8.10	1.64	9.88	10.00	2.63	5.00	74.60	3.15	2.50
140	*Syragold Egg Mash.* Syracuse Milling Co., Syracuse, N. Y.	*Higganum:* Felix Petrofsky...	9.85	7.39	19.88	18.00	6.53	8.00	51.62	4.73	3.00
139	*Syragold Growing Mash.* Syracuse Milling Co., Syracuse, N. Y.	*Higganum:* Felix Petrofsky...	9.65	10.13	17.06	16.00	3.50	7.00	54.86	4.80	4.00
334	*Syragold Laying Mash with Buttermilk.* Syracuse Milling Co., Syracuse, N. Y.	*Manchester :* Little & McKinney	8.88	11.32	19.88	18.00	7.73	9.00	47.51	4.68	3.00
141	*Syragold Scratch Grains.* Syracuse Milling Co., Syracuse, N. Y.	*Higganum:* Felix Petrofsky...	12.10	1.67	10.63	10.00	2.95	5.00	69.70	2.95	2.50
8796	*Thomaston Egg Mash.* Thomaston Supply Co., Thomaston, Conn.	*Thomaston:* Thomaston Supply Co.	7.65	9.80	20.25	20.00	7.48	7.00	50.17	4.65	4.50
8798	*Thomaston Scratch Feed.* Thomaston Supply Co., Thomaston, Conn.	*Thomaston:* Thomaston Supply Co.	10.10	2.05	10.44	10.00	3.01	5.00	69.70	4.70	4.00
8758	*Chicatine.* Tioga Empire Feed Mills, Waverly, N. Y.	*South Norwalk:* Roodner Feed Co.	9.33	6.99	20.88	18.00	4.08	6.00	53.67	5.05	3.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1928—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*		%	%	%	%	%	%	%	%	%
	Poultry Feeds—Concluded.										
257	*Derby Scratch Feed.* Tioga Empire Feed Mills, Waverly, N. Y.	*Hawleyville:* W. A. Honan	11.80	1.96	11.19	9.00	3.53	4.50	68.89	2.63	2.04
8756	*Egatine.* Tioga Empire Feed Mills, Waverly, N. Y.	*South Norwalk:* Roodner Feed Co.	8.95	8.30	25.56	23.00	4.50	6.00	47.74	4.95	2.50
8789	*Neverfail Scratch Feed.* Tioga Empire Feed Mills, Waverly, N. Y.	*South Norwalk:* Roodner Feed Co.	10.60	1.54	10.19	9.00	3.00	5.00	71.92	2.75	1.50
8614	*Tioga Growing Grains.* Tioga-Empire Feed Mills, Waverly, N. Y.	*Southport:* C. Buckingham & Co.	7.10	6.57	10.75	10.00	1.83	4.00	70.10	3.65	2.50
258	*Tioga Laying Food.* Tioga Empire Feed Mills, Waverly, N. Y.	*Hawleyville:* W. A. Honan	8.98	7.28	18.88	17.00	5.98	6.00	53.10	5.78	2.50
8628	*Advance Scratch, No Grit.* Vitality Mills, Inc., Chicago Ill.	*East Bridgeport:* Kaplan Feed Co.	6.60	1.61	9.63	10.00	2.20	6.00	77.33	2.63	2.00

8618	*Vitality Chick Starter.* Vitality Mills, Inc., Chicago, Ill.	*East Bridgeport:* Kaplan Feed Co.	5.95	7.45	16.06	15.00	5.10	6.00	60.04	5.40	5.00
8619	*Vitality Egg Mash.* Vitality Mills, Inc., Chicago, Ill.	*East Bridgeport:* Kaplan Feed Co.	5.40	15.45	20.38	20.00	4.45	8.00	19.22	5.10	4.00
8622	*Vitality Fine Chick Scratch.* Vitality Mills, Inc., Chicago, Ill.	*East Bridgeport:* Kaplan Feed Co.	5.60	1.64	10.94	10.00	1.60	3.00	76.29	3.93	3.50
9998	*Vitality Growing Mash.* Vitality Mills, Inc., Chicago, Ill.	*Plantsville:* C. A. Cowles	10.10	13.60	17.56	15.00	4.38	6.00	49.81	4 55	5.00
8620	*Vitality Scratch Feed, No Grit.* Vitality Mills, Inc., Chicago, Ill.	*East Bridgeport:* Kaplan Feed Co.	7.25	1.44	10.50	10.00	2.13	5.00	75.90	2.78	2.50
217	*Washburn's Gold Medal Vitamin Egg Mash, containing Wheat Germ (embryo).* Washburn-Crosby Co., Minneapolis, Minn.	*New Milford:* Geo. T. Soule	9.08	9.27	20.94	20.00	6.43	7.00	49.18	5.10	5.00
349	*Big (Y) Growing Feed.* Yantic Grain & Products Co., Norwich, Conn.	*Willimantic:* Boston Grain Co.	9.68	7.64	18.06	17.00	5.50	7.00	54.32	4.80	4.00
350	*Big (Y) Laying Mash.* Yantic Grain & Products Co., Norwich, Conn.	*Willimantic:* Boston Grain Co.	9.18	9.96	16.88	17.00	6.55	7.00	51.73	5.70	4.00
314	*Ging'm Gal Scratch Feed.* Yantic Grain & Products Co., Norwich, Conn.	*New London:* New London Grain Co.	12.40	1.66	10.50	10.00	2.85	5.00	70.21	2.38	3.00
351	*Uncas Scratch Feed.* Yantic Grain & Products Co., Norwich, Conn.	*Stafford Springs:* Stafford Grainery	11.88	1.65	10.38	10.00	2.65	5.00	71.01	2.43	3.00
	Beef Scraps, Etc.										
8612	*Capital Meat & Bone Scrap.* American Agricultural Chemical Co., N. Y.	*Southport:* C. Buckingham Co.	6.35	30.27	45.00	45.00	2.20	3.00	8.83	7.35	6.00

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1928—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*		%	%	%	%	%	%	%	%	%
	Beef Scraps, Etc.										
220	*Protox Meat Scraps.* American Agricultural Chemical Co., N. Y.	*Botsford:* G. T. Rasmussen	8.10	21.08	55.56	55.00	2.38	3.00	3.65	9.23	6.00
7953	*Sterilized Steam Bone.* Apothecaries Hall Co., Waterbury, Conn.	*Watertown:* Watertown Co-op Assoc.	4.45	84.25	5.81	5.00	0.61	4.00	4.23	0.65	1.00
7944	*Atlan's Diamond Pick Meat and Bone Scraps.* Atlan Mfg. Co., Jersey City, N. J.	*Botsford:* G. T. Rasmussen	5.40	37.39	41.19	45.00	0.75	2.00	6.42	8.85	6.00
8082	*Atlan Diamond Meat Scrap.* Atlan Mfg. Co., Jersey City, N. J.	*Botsford:* G. T. Rasmussen	5.65	36.62	42.50	45.00	.....	.....	10.10	5.13	6.00
221	*Atlan's Diamond Pick Meat & Bone Scrap.* Jersey City, N. J.	*Botsford:* G. T. Rasmussen	6.38	38.00	43.88	45.00	1.33	2.00	0.81	9.60	6.00
222	*"Atco".* Atlantic Coast Fisheries Corp., N. Y.	*Winsted:* E. Manchester & Sons	9.18	18.17	70.63	60.00	0.33	0.50	0.31	1.38	0.50

300	*Beach Star Brand Beef Scrap.* Beach Soap Co., Lawrence, Mass.	*Willimantic:* Windham Grain Store	6.30	32.36	44.50	40.00	1.55	2.50	3.16	12.13	10.00
261	*Dried Skim Milk.* Bell Isle Creamery Co., Owosso, Mich.	*East Haven:* A. W. Forbes	6.68	8.61	34.50	32.00	.....	.....	49.46	0.75	.....
7591	*Buell Boston Dried Skim Milk.* C. E. Buell Inc., Boston, Mass.	*Guilford:* F. C. Morse	7.70	7.89	34.63	31.00	.....	.....	48.76[1]	1.02	0.20
413	*Buell Boston Dried Skim Milk.* C. E. Buell, Inc., Boston, Mass.	*Westville Branch:* R. G. Davis & Sons	5.80	7.94	33.13	31.00	.....	.....	52.35	0.78	0.20
8637	*B & B Brand Roller Process Dried Skim Milk.* C. E. Buell Inc., Boston, Mass.	*Waterbury:* Spencer Grain Co.	2.43	8.22	36.50	31.00	.....	.....	52.65	0.20	0.20
161	*Burck-Brand Powdered Skim Milk.* C. W. Burckhalter, Inc., N. Y.	*Naugatuck:* Spencer Grain Co.	7.30	6.95	32.50	32.00	.....	.....	52.40	0.85	0.75
8310	*Conn. Fat Rendering & Fertilizer Corp. Meat Scrap.* Conn. Fat Rendering & Fertilizer Corp., New Haven, Conn.	*East Haven:* A. W. Forbes	5.55	29.59	48.31	45.00	1.68	.....	3.97	10.90	10.00
8568	*Corenco Bone Meal for Poultry.* Consolidated Rendering Co., Boston, Mass.	*Derby:* Peterson-Hendee Co.	4.78	65.33	24.13	20.00	.....	.....	2.61	3.15	3.00
8194	*Dried Skim Milk Powder.* Eastern Grain Co., Bridgewater, Mass.	*Wallingford:* A. E. Hall	5.50	7.83	34.88	32.00	.....	.....	50.34	1.45	0.75
8660	*Dried Skim Milk Powder.* Eastern Grain Co., Bridgewater, Mass.	*Wallingford:* A. E. Hall	4.70	8.22	34.25	32.00	.....	.....	52.09	0.74	0.75

[1] Includes fiber.

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1928—*Continued.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Continued.*		%	%	%	%	%	%	%	%	%
	Beef Scraps, Continued.										
360	*Butterfly Brand Dry Skim Milk.* S. T. Edwards & Co., Chicago, Ill	*West Cheshire:* Cheshire Grain & Coal	6.40	7.95	33.69	36.00	.....	.....	50.91	1.05	1.00
8553	*Frisbie's Poultry Feed 45%.* L. T. Frisbie Co., New Haven, Conn	*Bristol:* Bristol Grain & Supply Co	3.85	31.73	48.56	45.00	.....	.....	5.56	10.30	8.00
316	*Cooked Meat & Bone Scrap.* A. G. Markham & Co., Springfield, Mass	*Mansfield Depot:* Martin M. Hansen	7.90	33.16	47.25	45.00	.....	.....	3.49	8.20	8.00
317	*Special Cooked Meat & Bone Scrap.* A. G. Markham & Co., Springfield, Mass	*West Willington:* H. M. Hansen	6.58	27.97	50.63	50.00	.....	.....	3.27	11.55	8.00
24	*Morse's Meat Scraps for Poultry.* Jas. F. Morse & Son, Somerville, Mass	*Kensington:* S. F. Labieniec	5.90	35.71	41.50	40.00	4.15	.....	3.74	9.00	8.00

178	*Morse's Meat Scraps for Poultry.* Jas. F. Morse & Son, Somerville, Mass.	*Thomaston:* Thomaston Supply Co.	6.58	29.98	48.50	50.00	.....	.....	4.76	10.18	8.00
8488	*Blue Seal Meat Scraps.* New England By-Products Corp., Lawrence, Mass.	*Plantsville:* C. A. Cowles	6.00	33.63	47.19	50.00	1.60	3.00	1.53	10.05	5.00
6	*Gold Seal Dried Skim Milk.* New England By-Products Corp., Lawrence, Mass.	*Plantsville:* C. A. Cowles	7.23	7.84	33.88	35.00	.....	.....	49.90	1.15	1.00
319	*Gold Seal Dried Skim Milk.* New England By-Products Corp., Lawrence, Mass.	*Plantsville:* C. A. Cowles	6.95	7.86	33.94	35.00	.....	.....	50.17	1.08	1.00
8489	*White Seal Meat Scraps.* New England By-Products Corp., Lawrence, Mass.	*Plantsville:* C. A. Cowles	6.30	44.47	39.13	40.00	1.28	4.00	1.34	7.48	5.00
8485	*Norton's H. G. Meat & Bone Poultry Food.* Norton Tallow Co., Somerville, Mass.	*Norwich:* Yantic Grain & Products Co.	3.20	33.21	42.69	40.00	.....	.....	11.05	9.85	8.00
7919	*Reardon's Meat Scrap.* John Reardon & Sons Co., Cambridge, Mass.	*Westerly:* C. W. Campbell Co.	6.63	27.11	55.00	55.00	2.30	3.00	.....	8.96	6.00
326	*Register Brand 55%.* John Reardon & Sons Co., Cambridge, Mass.	*Stonington:* C. W. Campbell	6.40	26.21	55.56	55.00	.....	.....	4.08	7.75	6.00
327	*Register Brand 45%.* John Reardon & Sons Co., Cambridge, Mass.	*Mystic:* C. W. Campbell Co.	5.33	32.21	47.50	45.00	.....	.....	5.11	9.85	6.00
7842	*Chapman's Special Odorless Steamed Bone Meal.* Riverdale Products Co., Chicago, Ill.	*Middletown:* Meech & Stoddard, Inc.	2.64	87.46	4.69	5.00	.....	.....	4.51	0.70	1.50
7586	*Edible Bone Flour for Cattle & Poultry.* Rogers & Hubbard Co., Portland, Conn.	*Rockville:* Rockville Grain & Coal Co.	10.37	.....	23.88	23.85	.....	.....	.....	0.38	0.25

TABLE I. ANALYSES OF COMMERCIAL FEEDS, INSPECTION OF 1928—*Concluded.*

Station No.	Manufacturer and Brand	Retail Dealer	Pounds per Hundred								
			Water	Ash	Protein (N x 6.25)		Fiber		Nitrogen-free extract (starch, gum, etc.)	Fat	
					Found	Guaranteed, not less than	Found	Guaranteed, not more than		Found	Guaranteed, not less than
	PROPRIETARY MIXED FEEDS—*Concluded.*		%	%	%	%	%	%	%	%	%
	Beef Scraps, Etc.—Concluded.										
8793	*Rogers & Hubbard's Edible Bone Flour for Cattle & Poultry.* Rogers & Hubbard Co., Portland, Conn.	*Thomaston:* Thomaston Supply Co.	6.70	65.09	24.69	23.85	.....	.....	3.12	0.40	0.25
7910	*Chic Chuck "The Ideal Concentrated Poultry Food".* Russia Cement Co., Gloucester, Mass.	*South Coventry:* E. W. Latimer	7.96	36.60	52.19	45.00	0.65	1.00	1.30	1.30	0.10
254	*Ground Meat Scraps.* Springfield Rendering Co., Springfield, Mass.	*Thompsonville:* Geo. S. Phelps & Co.	7.28	34.28	47.13	45.00	.....	.....	2.78	8.53	8.00
7947	*Stanley's 45 Protein Meat & Bone Scrap.* John T. Stanley Co., N. Y.	*Long Hill:* Long Hill Feed Store	6.20	34.53	42.06	45.00	1.31	3.00	5.25	10.65	10.00
131[1]	*Stanley's Meat & Bone.* John T. Stanley Co., New York City	*Long Hill:* Long Hill Feed Store	6.98	33.36	41.00	45.00	1.43	3.00	4.53	12.70	10.00

[1] Old stock, 1927.

8193	*Struven's Fish Meal.* Chas. M. Struven & Co., Baltimore, Md.	*Middletown:* Meech & Stoddard, Inc.	5.59	20.49	61.50	55.00	0.50	2.00	5.47	6.45	4.00
8636	*Vico Meat Scraps.* Van Iderstine Co., Long Island City, N. Y.	*New Milford:* Geo. T. Soule ..	1.00	28.23	50.00	55.00	1.70	3.00	6.94	12.13	5.00
336	*P. W. Meat Scraps.* Worcester Rendering Co., Auburn, Mass.	*Willimantic:* Boston Grain Co.	7.35	35.25	42.88	45.00	.....	.....	5.24	9.28	8.00
337	*P. W. Special Meat Scraps.* Worcester Rendering Co., Auburn, Mass.	*West Willington:* H. M. Hansen	6.80	25.20	56.06	55.00	.....	.....	2.14	9.80	8.00

TABLE II. ANALYSES OF FEED SUBMITTED BY INDIVIDUALS.

Station No.	Material	Submitted by	Pounds Per Hundred					
			Water	Ash	Protein (N x 6.25)	Fiber	Nitrogen-free extract (starch, gum, etc.)	Ether Extract (Crude fat)
	BREWERS' AND DISTILLERS' PRODUCTS *Dairy Rations, etc.*		%	%	%	%	%	%
9033	Distillers' Grains	*New York City:* C. J. Martinis Grain Co.	7.65	....	25.13	12.72	....	8.55
7593	Dairy Feed	*Wallingford:* Barnes Co.	12.93	9.90	21.31	10.10	41.60	4.16
8748	Dairy Feed	*Bristol:* Bristol Grain & Supply Co.	8.02	4.21	15.19	8.03	60.00	4.55
9408	C. B. Dairy Feed	*Southport:* C. Buckingham & Co.	8 78	....	23.25	8.35	....	4.18
7774	Fortune *20%* Molasses Dairy Feed	*Middletown:* The Coles Co.	12.10	7.95	22.19	6.40	46.31	5.05
7775	Fortune *24%* Molasses Dairy Feed	*Middletown:* The Coles Co.	11.30	8.28	24.50	7.55	41.67	6.70
8009	Dairy Ration	*Middletown:* The Coles Co.	8 46	....	23.44	9.25	....	3.95
8077	Dairy Ration	*Middletown:* The Coles Co.	9 60	....	21.19	8.95	...	3.55
8089	Dairy Ration No. 2	*Middletown:* The Coles Co.	9.20	....	21.75	8.83	....	10.45
37	Dairy Ration	*Middletown:* The Coles Co.	8.48	8.45	20.56	13.15	45.80	3.56
228	Dairy Feed	*Middletown:* The Coles Co.	6.65	9.46	27.13	7.85	44.41	4.50
7537	Dairy Ration No. 2	*New Haven:* R. G. Davis & Sons	11.93	....	20.81	7.86	....	8.50
8000	Naugatuck Dairy Ration	*Naugatuck:* Davis Feed Store	9.60	....	19.56	10.90	....	4.14

8011	Institutional *20%* Dairy Feed..	*Falls Village:* H. E. Dean.....	9.86	....	17.88	9.65	....	4.50
8012	Institutional *24%* Dairy Feed..	*Falls Village:* H. E. Dean.....	9.35	....	19.44	6.55	....	3.35
8073	Dairy Feed.....	*Kensington:* S. F. Labieniec....	9.94	....	21.69	7.70	....	4.80
7756	Dairy Ration with Molasses...	*Guilford:* F. C. Morse.....	11.60	7.38	24.38	7.79	44.50	4.35
8130	Dairy Feed No. 1.....	*St. Albans, Vt.:* St. Albans Grain Co.....	8.73	11.15	21.50	7.88	46.59	4.15
8131	Dairy Feed No. 2.....	*St. Albans, Vt.:* St. Albans Grain Co.....	8.35	10.48	24.88	7.18	45.10	4.01
8132	Dairy Feed No. 3.....	*St. Albans, Vt.:* St. Albans Grain Co.....	8.40	8.02	25.75	7.98	45.22	4.63
8133	Dairy Feed No. 4.....	*Stl Albans, Vt.:* St. Albans Grain Co.....	8.50	5.33	19.50	7.63	53.89	5.15
8134	Dairy Feed No. 5.....	*St. Albans, Vt.:* St. Albans Grain Co.....	8.10	6.64	25.06	8.86	46.22	5.30
8135	Dairy Feed No. 6.....	*St. Albans, Vt.:* St. Albans Grain Co.....	8.71	9.70	21.88	7.25	47.96	4.50
8136	Dairy Feed No. 7.....	*St. Albans, Vt.:* St. Albans Grain Co.....	8 53	7.53	22.13	7.30	49.63	4.88
8137	Dairy Feed No. 8.....	*St. Albans, Vt.:* St. Albans Grain Co.....	7.90	11.62	21.75	9.58	45.15	4.00
8363	Big Value Dairy Ration.....	*Wallingford:* Ray R. Stevens...	5.95	....	21.88	9.83	....	4.82
423	Dairy Mixture.....	*Southbury:* H. R. Stone.....	9.33	7.27	21.25	8.53	48.88	4.74
8977	Syragold Milk Ration.....	*Bridgeport:* E. C. Dana.....	7.60	....	19.81	9.35	....	5.70
	Poultry Feeds.							
8001	Bristol Laying Mash.....	*Bristol:* Bristol Grain & Supply Co.....	8.68	....	20.75	7.23	....	5.45
8002	Bristol Scratch Feed.....	*Bristol:* Bristol Grain & Supply Co.....	10.85	....	9.75	1.88	....	3.70
7960	Scratch Feed.....	*Southport:* C. Buckingham & Co.	10.38	1.88	11.19	3.80	69.99	2.76
7788	Steamed Bone Meal.....	*Westerly:* C. W. Campbell Co...	2.61	89.98	3.44	....	3.02	0.95

TABLE II. ANALYSES OF FEEDS SUBMITTED BY INDIVIDUALS—*Concluded.*

Station No.	Material.	Submitted by	Pounds Per Hundred					
			Water	Ash	Protein (N x 6.25)	Fiber	Nitrogen-free extract (starch, gum, etc.)	Ether Extract (Crude fat)
	BREWERS' AND DISTILLERS' PRODUCTS—*Concluded*		%	%	%	%	%	%
	Poultry Feeds—Concluded.							
486	Square Deal Buttermilk Laying Mash	*Long Hill:* Long Hill Feed Store	7.05	15.95	20.13	7.33	44.84	4.70
7956	Poultry Mash	*Branford:* Sagalou Farms	11.10	8.53	16.00	5.78	54.14	4.45
7616	Laying Mash	*Torrington:* D. L. Talcott	11.20	....	17.88	8.99	....	5.08
7673	Beef Scrap	*Thomaston:* Thomaston Supply Co.	9.05	....	40.50	....	....	10.21
6402	New England Special Concentrated Buttermilk	*Plainville:* M. Kosenko	....	3.21	11.44	....	....	2.18
	MISCELLANEOUS.							
7562	Alfalfa Meal No. 1	*Rockville:* Samuel Kostolefsky	6.10	30.20	11.50	9.40	41.75	1.05
7563	Alfalfa Meal No. 2	*Rockville:* Samuel Kostolefsky	7.28	37.30	8.44	10.45	35.03	1.50

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New Haven, Connecticut

THE ASIATIC BEETLE IN CONNECTICUT

Roger B. Friend

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The Asiatic Beetle in Connecticut*

Roger B. Friend

INTRODUCTION

The Asiatic beetle, *Anomala orientalis* Waterhouse, presumably imported into Connecticut directly from Japan, is a serious pest of lawns in New Haven. It has not become abundant over any great area in the United States as yet, and its status as an enemy to agriculture is not known, although it has injured sugar-cane in Hawaii. However, there is no question as to the damage the larvae can do to lawns in a residential district. Over $30,000 has been spent from State and Federal funds in a territory about one mile square, and the inhabitants of that territory have probably spent at least an equal sum in an effort to prevent the spread of the insect from the infested area to other parts of the State.

This bulletin includes the results of the investigations carried out by the writer at New Haven, Connecticut, on the biology and control of the Asiatic beetle during the years 1926, 1927, and 1928. In view of the fact that this is an introduced species which seems to have become well established, a brief discussion is given of the climatic and soil conditions of the infested region. It is hoped that the pages given over to the description of the various stages will aid in determining the species, for the adults vary in color, and the immature stages superficially resemble other Scarabaeidae. The observations on the life history and habits cover three seasons, but most of the control work described in this bulletin was carreid out in 1928.

From the first, this work was planned as a co-operative project between the Federal Bureau of Entomology and this Station, and Mr. Loren B. Smith, of the Japanese Beetle laboratory has made many helpful suggestions during the progress of the investigations. Messrs. Fleming, Fox, Lipp, Hallock, King, and Smith of the Bureau have reviewed the manuscript of this bulletin and made some helpful criticisms, for which the writer expresses his appreciation.

The writer was assisted in the work during 1926 by Mr. Paul A. Davis, in 1927 by Mr. George R. Biecher, and in 1928 by Mr. Benj. W. McFarland.

Assistance has also been given the writer at various times by members of the staff of the Experiment Station, particularly

*The Japanese Beetle Laboratory of the Bureau of Entomology, U. S. D. A., has collaborated with the Connecticut Agricultural Experiment Station in planning and carrying out these investigations.

Messrs. Fisher, Walden, Johnson, Morgan, and Jacobson. A number of citizens of Westville, New Haven, have permitted their lawns to be used for experimental purposes, not always to the benefit of the property, and the general co-operation by the inhabitants of this part of New Haven has been excellent. The entire Asiatic beetle project has been under the direction of the Station Entomologist, Dr. W. E. Britton. To all these, the writer expresses his thanks.

HISTORY AND DISTRIBUTION

Anomala orientalis was first described by Waterhouse in 1875 from specimens taken in Japan and the habitat given as Kawachi, Nagasaki, and Hakodadi. In 1895, Lewis revised the Lamellicornia of Japan and stated that the beetle occurred on all the islands. Some time before 1908, according to Muir, it was imported into Hawaii and became established in the cane fields on the island of Oahu. In 1920 adults were collected in a nursery in New Haven, Connecticut, and in 1922 complaint was received of severe injury to lawns by the larvae. In view of the fact that this nursery imported plants, some of them with earth about the roots, from Japan in 1911, 1912, and 1916, it is probable that the insect came directly from Japan on imported nursery stock. There were two small infestations of beetles in West Haven, one of which has been eradicated, a few miles from the New Haven infestation, but except for this there are now no known infested areas in Connecticut outside of New Haven. The West Haven infestations were probably started by beetles accidentally brought from New Haven. In 1926, the beetle was discovered in Jericho, Long Island, New York, and it has since been found in large numbers there and in neighboring towns. Whether the beetles on Long Island came directly from Japan or are the result of a spread from New Haven is not known, and there is, of course, the remote possibility that the beetles spread from Long Island to New Haven. Since 1925 a few beetles have been found in several towns in Westchester County, New York, and Elizabeth, New Jersey and larvae have been found in Rutherford, New Jersey. The known distribution of *Anomala orientalis* includes the islands of Japan; Oahu Island in the Territory of Hawaii; New Haven and West Haven, Connecticut; Long Island and Westchester County, New York; Elizabeth and Rutherford, New Jersey. In the United States the larvae occur in the turf of lawns and similar places, and have not yet been found to injure agricultural crops. At Rutherford, N. J., at several localities in Westchester County, and on Long Island, New York, and at New Haven, Connecticut, this insect is present in sufficiently large numbers to be considered a serious pest. There is a possibility that it may become injurious to grain and forage crops some time in the future unless its increase and spread are checked.

Aside from the evidence furnished by the dates of importation of nursery stock from Japan, the great abundance of larvae found in lawns in New Haven, where instances of 1000 grubs per square yard of turf are not rare, indicates that this insect was present several years prior to its discovery in 1920. The rate of reproduction is not high when compared with that of other insects, nor is the natural spread very rapid. In Hawaii, where there are at least two generations a year and perhaps three, the known dis-

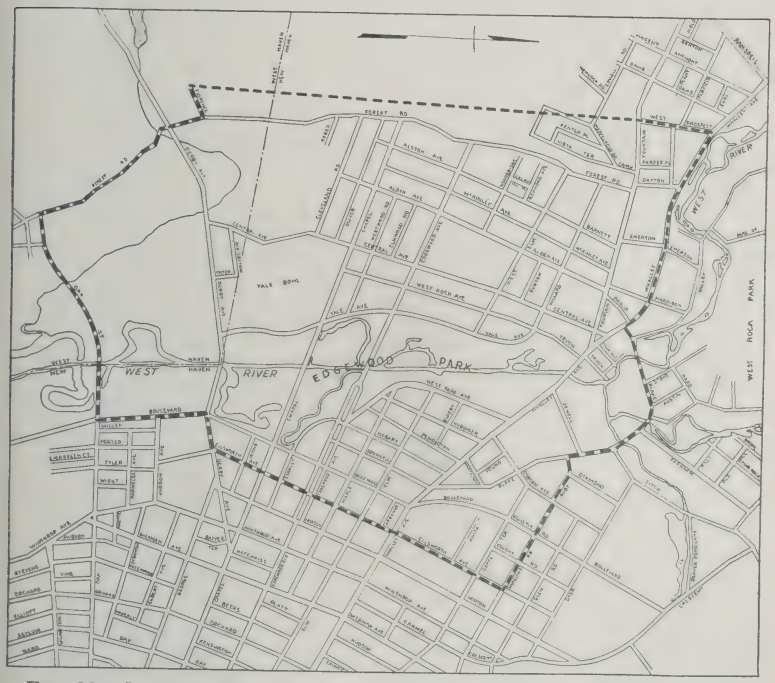

FIG. 33. Map of the Westville section of the City of New Haven. The area enclosed by the heavy dotted line is now quarantined on account of the Asiatic Beetle.

tribution in 1918, at least ten years after introduction, extended over an area of but six square miles. There is but one generation a year in New Haven and when one considers the habits of the insect and the tendency to concentrate in small areas, it is not remarkable that the present known infested area here should cover only about one square mile (Fig. 33). The adults do not fly far nor much of the time, and they are difficult to discover. In 1926, twelve scouts secured 2402 adults in two months, which is a small number compared with the number of larvae present in any one infested lawn. The larvae are easily confused with

those of other Scarabaeidae, and no injury to grass is apparent when the infestation is below about 150 larvae per square yard. It is quite possible that this insect occurs in localities where it is at present unknown. There was no quarantine in force in Connecticut until 1926, and the Japanese beetle quarantine, which would affect the distribution of Anomala larvae, was not extended to include the Long Island infestation until the same year. Up

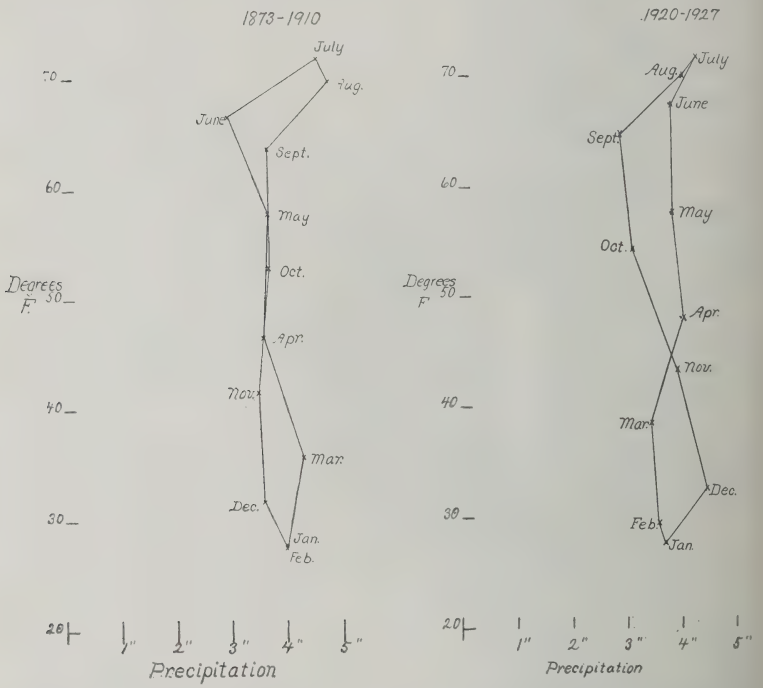

FIG. 34. Mean Monthly temperature and precipitation for the periods 1873–1910 and 1920–1927 at New Haven, Conn.

to this time plants with soil about the roots could have been freely shipped to any part of the country from the infested territory, and the larvae could have become distributed in this soil.

NATURAL CONDITIONS IN NEW HAVEN

The Asiatic beetle is indigenous to Japan and has flourished in the Territory of Hawaii, giving it a great range of latitude and a variety of natural conditions in those regions. It has in late years firmly established itself in Connecticut and some of the immediately surrounding sections. A brief summary of the natural

conditions in New Haven is therefore pertinent to the subject and may aid in determining the possible future distribution of the insect in North America.

According to the definition of the life zones of the United States as given by C. Hart Merriam (1898) the coastal strip of

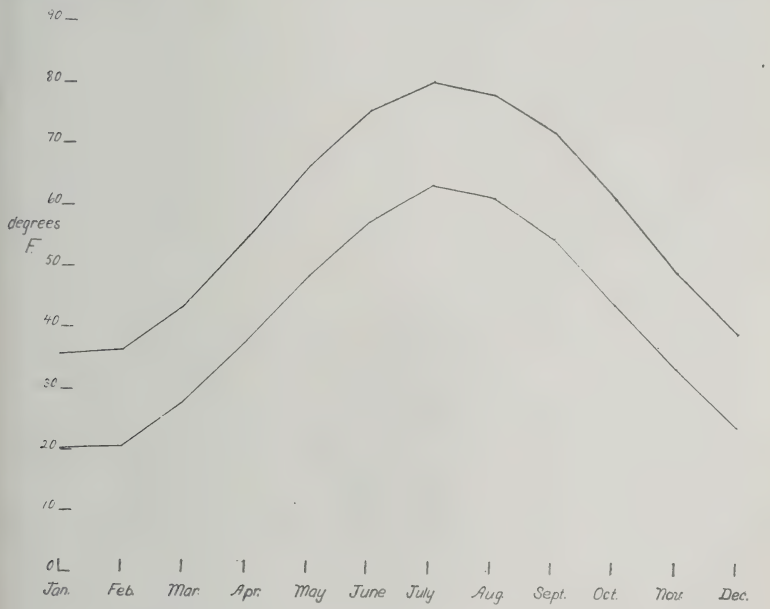

FIG. 35. Mean monthly maximum and minimum temperatures for the years 1873–1910 inclusive at New Haven, Conn.

Connecticut, approximately five to ten miles wide, and a strip of equal width along the Connecticut River to the northern boundary of the State are in the Upper Austral, the rest of the State being Transition. New Haven lies in the coastal strip and hence the area in which the Asiatic beetle is now found lies in the Upper Austral.

The mean temperature and precipitation for two periods, 1873-1910 inclusive and 1920-1927 inclusive are given in Figure 34, the data being obtained from the New Haven station of the U. S. Weather Bureau. The period covering the years 1873-1910 gives what is more nearly the mean conditions for New Haven, and the period from 1920 to 1927 covers the first seven years during which the Asiatic beetle was known to be present here. The temperature means of the two periods are nearly the same, but the precipitation differs somewhat. In Figure 35 are given the mean maximum and mean minimum temperature for the

years 1873 to 1910 inclusive and these adequately represent conditions for 1920 to 1927. Table 1 contains the data on which both figures are based.

The section of New Haven which is at present infested with the Asiatic beetle has a surface soil to a depth of about eight inches of brown sandy loam which contains two to three per cent. organic matter. The subsoil to a depth of 24 to 30 inches is a reddish yellow brown gravelly sandy loam, and this overlies coarse gravel and sand of Triassic red sandstone material. In the soil survey, this is classified as Hartford sandy loam. It is developed on a nearly level terrace of stratified glacial drift. Along the eastern side of the more heavily infested area the ground slopes sharply, giving many of the lawns steep banks. All of the heavily infested area is in a residential district, and the original soil profile has been much changed by building operations. The fertilization and care given the lawns have modified the upper layer of soil in many places. In most of the lawns, the acidity of the upper three inches is about Ph 6. 0, although this varies somewhat in different properties. The larvae are found in lawns all over the area, both level and steeply sloping, and are frequently found in cultivated gardens and around shrubbery, although the visible injury is confined to the lawns. The lawns are usually seeded to lawn mixtures in which red top and blue grass predominate, with a smaller percentage of other lawn grasses. White clover is often present in the turf in varying amounts. The soil is rather light and during September the injury caused by the beetle larvae is often accentuated by a period of dry weather. If crab grass has come into the lawn, as it frequently does, the turf has a very bad appearance in October regardless of the number of beetle larvae present or the weather conditions.

TABLE 1—MEAN TEMPERATURE AND PRECIPITATION AT NEW HAVEN, CONN.

	1873-1910 Inclusive.				1920-1927 Inclusive	
	Temperature					
Month	Mean Maximum Deg. F.	Mean Minimum Deg. F.	Mean Deg. F.	Precipitation Inches	Temperature Mean	Precipitation Inches
January	35.7	20.1	27.9	4.01	27.7	3.67
February	36.2	20.4	27.6	4.01	29.5	3.58
March	43.4	28.0	35.7	4.31	38.6	3.44
April	55.0	38.0	46.5	3.61	48.0	4.05
May	66.6	48.6	57.6	3.71	57.5	3.84
June	75.6	57.5	66.6	3.04	67.3	3.83
July	80.3	63.4	71.8	4.60	71.8	4.29
August	78.2	61.4	69.8	4.79	70.0	4.04
September	72.2	55.1	63.7	3.73	64.9	2.92
October	61.5	44.1	52.8	3.74	54.1	3.16
November	49.3	34.0	41.6	3.54	43.3	3.93
December	39.4	24.4	31.9	3.63	32.8	4.43

SYSTEMATIC POSITION

The genus Anomala belongs to the tribe Anomalini, sub-family Rutelinae, of the family Scarabaeidae. Arrow (1910) in classifying the Lamellicornia, uses the division of the Scarabaeidae into Pleurosticti and Laprosticti, the former having the posterior spiracles situated in the dorsal part of the chitinous ventral segments, as is shown in Figure 43 of this bulletin, and including the Rutelinae. The genus is readily defined by the characters given by Blatchley (1911) or by Casey (1915). In 1907 Schaeffer published a key to the adults of the genus Anomala inhabiting North America but not only does this key include species no longer placed in the genus but also separates species on the basis of color. The Asiatic beetle varies too much in color to permit the use of such a character as specific, and we have made no attempt to fit this species into that key. The adults may be readily separated from *Pachystethus lucicola* Fab., which they closely resemble in size and color, by the presence of a protuberance of the metasternum in the latter species, this protuberance being lacking in *Anomala.*

The larva of *Anomala orientalis* Waterh. may be easily distinguished from some other closely related forms. Böving (1921) has translated and published part of Schiodte's work on the larvae of Lamellicornia in which *Anomala aenaea* de G. is used as a type of the genus. Böving gave a systematic key to the larvae of the Scarabaeidae closely related to *Popillia japonica* Newm. and the larval characters of *Anomala orientalis* agree with the description of the genus Anomala as given by him except that the holes of the spiracular respiratory plate (Plate XVII) are not perfectly oblong, nor are the transverse rows perfectly regular, but the alternative is "angulate-rotundate" and "irregularly distributed" which is no closer to the true condition. A systematic description of the larva of *Anomala orientalis* is here given according to the formula of Schiodte and Böving for the sake of comparison with other Ruteline larvae. Some of the principal differences between the larva of *Anomala orientalis* and that of *Pachystethus lucicola* Fabricius and *Popillia japonica* Newman are mentioned here. A more complete description of the larva is given later in the morphological part of this bulletin.

Anomala orientalis Waterhouse

Epicranial suture with margins very slightly or not at all raised. Antennae with subapical joint equal in length to basal joint. Maxillary palpus with length of subapical joint to prebasal joint as 3 to 4. Length of tibia in proportion to femur about 4 to 5 (this varies because the length of the femur increases posteriorly; that is, the mesothoracic femur is longer than the prothoracic, and the metathoracic longer than the mesothoracic; whereas the respective tibiae more nearly equal each other in length). Claws of the third pair of legs shorter. Respiratory plate with oval holes placed in irregular transverse series (see paragraph above and Plate XVII).

The above description applies to the third instar larva. In the first instar the subapical-basal joint ratio of the antenna is about 2 to 3, and the tibiae are more nearly equal to the femora. In the second instar the basal antennal joint is slightly longer than the subapical joint, although not as much so as in the first instar, and the subapical-prebasal joint ratio of the maxillary palpus is 2 to 3.

The larva of *Pachystethus lucicola* is very similar in appearance to that of *Anomala orientalis* but may be distinguished by the following characters, which, in the case of *A. orientalis,* are constant in all instars. The frons of *A. orientalis* has a row of four setae close to the anterior margin, as shown in Figure 46. In *P. lucicola* there are two setae only, and these are in the position of the median two of *A. orientalis.* There are usually in *A. orientalis* about four large and two or three small setae in a more or less definite line each side of the epicranial suture posteriorly. In *P. lucicola* these setae are much less numerous. The labral setae also differ. In *A. orientalis* there are on the disc two setae, one each side of the mid-line, and posteriorly there are two fairly large and one or two minute setae each side of the mid-line. In *P. lucicola* there are two setae each side of the mid-line on the disc and one large seta on each side of the mid-line posteriorly. The claws of the third pair of legs in *Pachystethus* are the same length as those of the first two pairs, and the holes of the respiratory plate are angulate-rotundate and irregularly distributed. In *Anomala* the claws of the third pair of legs are shorter and the holes in the respiratory plate are oval in shape and arranged in irregular transverse rows. The two median rows of spines on the ventral side of the tenth abdominal segment in *Pachystethus lucicola* contain about ten spines each. In *Anomala orientalis* these two rows contain ten to sixteen spines each, 28 third instar larvae averaging 12.8 $\pm$ .2 right and 12.6 $\pm$ .2 left. The number of spines in these rows in some specimens would not in itself be sufficient to determine the species, but in most cases this character is dependable.

The larva of *Popillia japonica* Newman can be immediately distinguished from that of *A. orientalis* by the number, form, and arrangement of the spines on the tenth abdominal segment. In the former species there are about seven spines in each row, and the rows converge sharply anteriorly. The illustrations of *Popillia japonica* by Böving (1921) and Davis (1920) show this arrangement very clearly.

In comparing the above two species with *Anomala orientalis* I have used the morphological descriptions of Böving (1921).

Hayes (1928) has published a systematic description of the epipharynx of Lamellicorn larvae and a key to common genera based largely on the morphological differences in this structure.

The Asiatic beetle is included and can be readily differentiated from other common Scarabaeid larvae by the characters given.

DESCRIPTION OF STAGES

In the following pages there are given brief morphological descriptions of all stages of the insect. The primary purpose of this is not to present a detailed morphological study (and some of the details are therefore omitted) but such a description of the external anatomy as will enable one to distinguish the immature and adult stages from those of similar and closely related species. The material was all collected in New Haven and the larval and pupal descriptions were checked with reared material. For references to publications on the comparative morphology of the Scarabaeidae which form a basis for the description given here, the bibliography may be consulted.

The Adult

The original description of the adult by Waterhouse (1875) is as follows:

"*Ph. campestri* affinis. Obscure cupreo-aenea, elytris plerumque flavo-variegatis. Capite fere ut in *Ph. horticola*, fronte crebre punctulata, clypeo angulis rotundatis. Antennarum clava praelonga nigra. Thorace parum convexo, antice angustato, sat crebre fortiter punctato, lateribus arcuatis, angulis posticis obtusiusculis, basi fere rotundato, marginato. Scutello arcuatim triangulari, punctulato. Elytris thoracis basi latitudinem aequantibus postice paulo ampliatis, ad apicem obtusis, depressiusculis, fortiter striatis, striis fortiter irregulariter punctatis, interstitii convexis, subtiliter obsolete punctulatis.

"Long. 4-5½ lin.; lat. 2½-3 1–6 lin.

"Var. a. Testacea, fronte thoracisque maculis duabus aeneis;tarsis piceis.

"Var. b. Testacea, fronte thoracis limbo, elytrorumque fasciis duabus irregularibus aeneis.

"Var. c. Aenea, elytris nigro-piceis, flavo-maculatis.

"Besides the colouration this species varies much in form, the smaller specimens being more convex and slightly ovate; the sculpture of the elytra also varies, the interstices being almost rugulose in some specimens, whereas they are almost smooth in others.

"*Hab.*—Kawachi; Nagasaki; Hakodadi. (Common in May and June)."

The adults collected in New Haven conform to this general description (Plate XVII). They are elongate-oval in shape and typically Scarabaeid. The greatest width of the body is at a point about three-fourths of the distance from the base of the elytra to the tip. The elytra are striate, and the striae are punctate. The pygidium is fully exposed. The female abdomen is larger in proportion to the rest of the body than is the male abdomen, and the latter tends to be slightly concave on the ventral side, whereas the former is convex. The horizontal row of setae

on the eighth abdominal sternite follows a sinuate carina in the male, whereas in the female this row of setae follows the posterior margin of the sternite (Fig. 44). The labrum is concealed beneath the clypeus and does not appear in a dorsal view. The front legs are fossorial, though not extensively so developed. In the female, the prothoracic tibia is narrowly projected beyond the tarsal articulation, extending about to the base of the fourth tarsal joint. In the male, this projection is not quite as long and is much broader at the base, tapering more sharply (Fig. 39). The lamellae of the female antenna are distinctly shorter than the remainder of the antenna (Fig. 38), whereas in the male the lamellae are almost as long as the remainder of the antenna. These characters of the antenna and prothoracic tibia offer an easy means of determining the sex and are dealt with in more detail later.

The females are larger than the males, as the following measurements show, and both sexes show much variation. These adults were collected in the summer of 1927, pinned, and the measurements made in March, 1928. Fifty-seven females and 56 males, all taken in the act of copulation, were used (one male was lost). As an indication of the variation in width, the base of the prothorax has been used. This is more easily measured and less subject to distortion than the width of the elytra. The length was measured from the tip of the clypeus to the tip of the abdomen.

Table 2—Length of Body and Width of Prothorax of Adults.

		Male	Female
Length of entire body:	mean	9.05 ± .04 mm.	10.34 ± .07 mm.
	maximum	10.4 "	11.7 "
	minimum	8.2 "	8.9 "
	coefficient of variability	5.4	7.3
Width of prothorax:	mean	3.97 ± .02 mm.	4.46 ± .03 mm.
	maximum	4.5 "	5.1 "
	minimum	3.5 "	3.9 "
	coefficient of variability	5.5	6.5

The color of the adult varies from black to straw (about the honey-yellow of Ridgeway's color chart), with intermediate stages having black elytral bands and markings on the prothorax. The prothorax and head frequently have a bronze iridescence. In Figure 36 there are illustrated eight color types based on the color of the elytra and prothorax. These eight types vary within themselves and intergrade so that the individuals approximate only the types. There is no sexual color peculiarity, and both sexes show the same amount of variation. In the following table, the percentages of each color type are given of the 56 males and 57 females, of which the body measurements are given above, and

of 259 miscellaneous specimens. This tabulation is approximately true of all the adults collected in New Haven. Types 6 and 7 are given together as they really represent one type having one elytral bar and two distinct black areas on the prothorax. The thoracic markings of type 8 vary from light brown to black.

FIG. 36. Color variation of adults.

TABLE 3—COLOR VARIATION IN ADULTS.

Type	56 Males	57 Females	259 Miscellaneous	Total	Per cent
1	4	5	21	30	8.1
2	2	2	6	10	2.7
3	3	5	18	26	7.0
4	5	5	11	21	5.6
5	1	2	4	7	1.9
6 and 7	15	17	91	123	33.1
8	26	21	108	155	41.7
	56	57	259	372	100.1

The eight types are defined as follows:

1. Entirely black.
2. Thorax with one black mark, elytra with two black bars.
3. Thorax with one black mark, elytra with one black bar.
4. Thorax with one black mark, elytra entirely straw.
5. Thorax with two separate black marks, elytra with two black bars.
6. Thorax with two separate black marks, elytra with one black bar.
7. Thorax with two separate black marks, elytra with one black bar reduced.
8. Thorax with two separate dark marks, elytra entirely straw.

Almost half the adults have no elytral bars (types 4 and 8), and this is the most common type in New Haven. The coloration of adults found in other localities, where environmental conditions differ, may possibly not conform to the above, for environment causes regional variations in color among some beetles (see Tower, 1906), and this regional effect is not fixed genetically.

All the above data on coloration refer to the elytra and the dorsum of the prothorax. Other parts of the body show variations in color, although the general degree of pigmentation of the entire insect follows approximately the condition of the elytra and prothorax. The pygidium is usually light except in dark individuals of types 1 and 2, in the former of which it is always black and in the latter may be either black or straw. It frequently bears a dark band dorsally across the base. The ventral side of the abdomen and thorax varies from light to dark brown, but the thorax is usually darker, and the dorsum of the abdomen beneath the elytra is dark. The coxae and femora are usually straw-colored, and the latter frequently bear a dark brown longitudinal streak on the antero-ventral side. The legs darken towards the extremities, the tarsi being darker than the tibiae. The dorsal part of the head is usually black, often with a light area bordering the clypeus, and the latter is usually light brown. The lamellae of the antennae are dark but the remainder is pale. All individuals of type 1 are entirely black.

Head

The head is about as long from the occipital foramen to the anterior margin of the clypeus as it is wide at the eyes. It is normally partly withdrawn into the prothorax, and most of the occipital region is invisible.

The vertex (Fig. 37*a*) is not divided longitudinally by an epicranial suture, the dorsal part of the head capsule being fused into one piece. Except in the region of the occiput, normally overlapped by the prothorax, the vertex on the dorsal side is coarsely and thickly punctate. The occipital region, which is not distinctly separated from the vertex, contains a few fine punctures and has many fine setae laterally and ventrally. The vertex extends on the ventral side to the gula and is partly covered on this side by fine setae. On the lateral side of the head a short distance behind the eyes, there originates a suture which extends diagonally across the ventral side of the head to the anterior part of the gula. The head capsule does not readily separate along this line, and the suture may be a secondary structure rather than the occipital suture. On the dorsal side the vertex extends anteriorly to the suture separating it from the clypeus. According to Stickney (1923) this suture represents an invagination of the frons, and hence indicates the position of the arms of the

epicranial suture. A pair of depressions along the line of this suture, one on each side near the lateral margin of the head, indicate the position of the anterior condyle (precoila) on which the mandible articulates. This condyle is on the ventral side of the clypeus (Fig. 38*b*). The frontal pits are on the ventral side of the head just lateral of the precoilae.

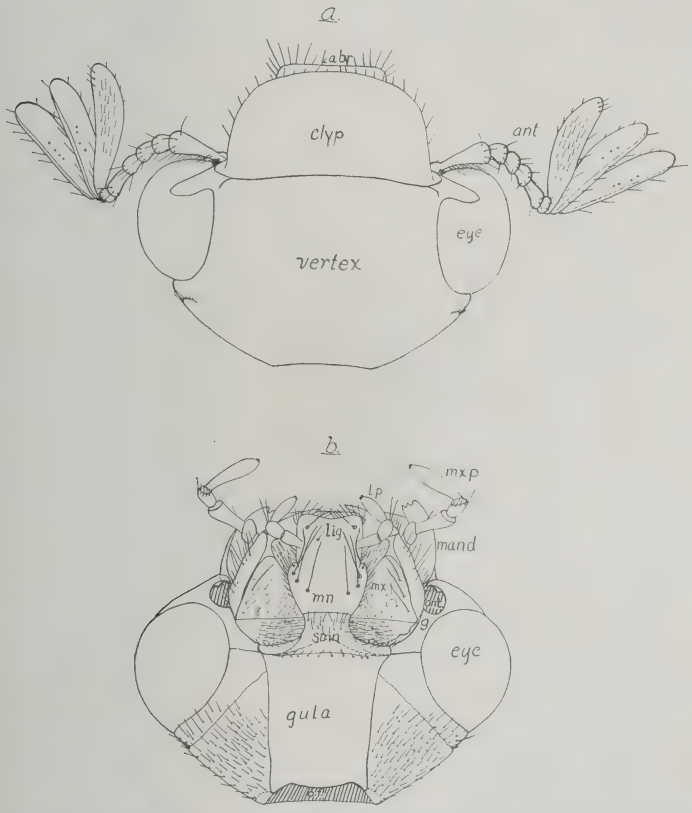

FIG. 37. The head, dorsal aspect above and ventral aspect below. *ant*, antenna; *clyp*, clypeus; *g*, gena; *labr*, labrum; *lig*, ligula; *lp*, labial palpus; *mand*, mandible; *mn*, mentum; *mx*, maxilla; *mxp*, maxillary palpus; *smn*, submentum.

From each anterior lateral angle of the vertex there extends posteriorly and partly over the eye a canthus. Between the eye and the mandible, on the ventral side of the head posterior to the antenna is the narrow gena. This is bounded posteriorly by a suture.

The clypeus (Figs. 37*a* and 38*b*) is approximately quadrate when viewed from the dorsal side. Its anterior margin is slightly

upturned, and the anterior part of the clypeus is folded ventrally on itself. The dorsally visible part represents most of the postclypeus and its surface is coarsely and thickly punctate like the vertex. Anteriorly the punctures become more shallow. Along the lateral and anterior margins of the postclypeus there is a row of setae. The anterior part of this postclypeus is reflected ventrally and lies on the ventral side just over the labrum. The preclypeus is membranous and lies on the ventral side of the postclypeus between the ventral reflected part of the latter and the labrum.

The antennae (Figs. 37*a* and 38*e*) are attached to the ventral side of the head between the eyes and the bases of the mandibles. There is a small condyle (antacoila) on the anterior margin of the antennal fossa, and the base of the scape of the antenna contains an acetabulum which serves for the reception of this condyle. Each antenna is composed of nine segments of which the last three comprise the lamellae. The first segment, or scape, is about as long as the following three segments combined. Segments two to five are progressively shorter, although only slightly so, and the sixth segment is the smallest, being wider than long. All of the first six segments bear setae at the distal ends, and the scape bears in addition a group of setae on the posterior side and one or two ventrally on the proximal end. The lamellae (segments seven to nine inclusive) differ in several respects in the two sexes. In the male, they are nearly equal in length, the first (seventh antennal segment) being very slightly longer than the other two, whereas in the female, the first is much longer than the others, the second distinctly shorter than the first, and the third (last antennal segment) much the shortest of the three. The first lamella of the female is about equal in length to segments two to six inclusive, whereas, the lamellae of the male are as long as all the remaining segments combined (one to six inclusive). The outer (proximal) side of the first lamella of the female is almost entirely covered with fine short setae. In the male, these setae are confined to a narrow oval area about one-third the length of the lamella. On the inner sides of lamellae one (distal side) and three (proximal side), and on both sides of lamella two there is a longitudinal row of shallow pits, presumably sensory in function, near the dorsal margin. The male has about six pits in each row and the female about four. There is a row of short setae around the margin of each lamella in both sexes, and the sides of the lamellae are finely punctate. When these last three segments of the antenna are closed they combine into a club, the outer faces of the first and third being convex and the inner faces of both, together with both faces of the second, being flat.

The compound eyes (Fig. 37) are approximately hemispherical and situated on the lateral sides of the head. Each is partly

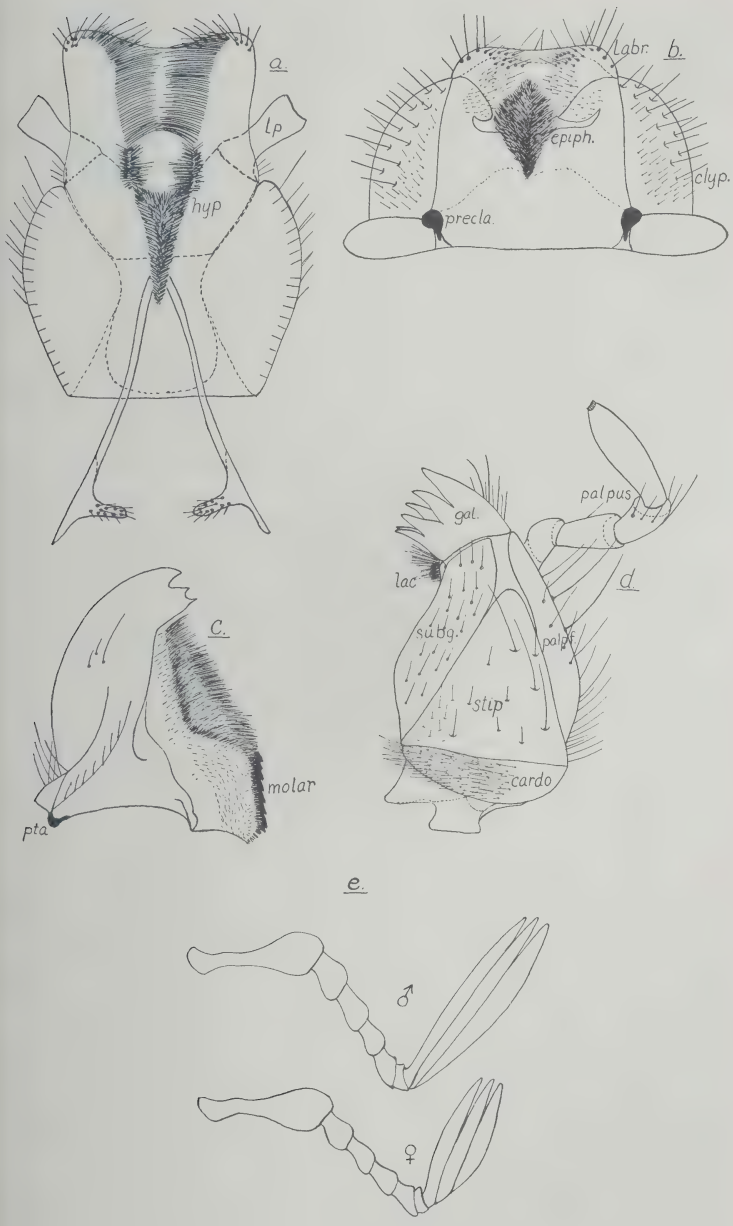

FIG. 38. a. Hypopharynx. b. Labrum and epipharynx. c. Right mandible, ventral aspect. d. Left maxilla, ventral aspect. e. Antennae, a male above, female below. *clyp*, clypeus; *epiph*, epipharynx; *gal*, galea; *hyp*, hypopharynx; *labr*, labrum; lac, lacinia; *lp*, labial palpus; *palpf*; palpifer; *precla*, precoila; *pta*, postartis; *stip*, stipes; *subg*, subgalea. Figures not all drawn to the same scale.

divided by a canthus which extends from the anterior side posteriorly about one-third of the distance across the eye. This canthus is part of the vertex and has been mentioned previously. There are no ocelli.

The gula (Fig. 37*b*) extends on the ventral side of the head from the occipital foramen to the submentum. It is a broad quadrangular sclerite with a smooth surface and no setae except a few in a row along the anterior margin. These are short and inconspicuous.

The submentum (Fig. 37*b*) is a distinct sclerite bearing several small fine setae. Its posterior part extends laterally toward the cardines of the maxillae.

The mentum will be described with the labium.

The labrum (Figs. 37*a* and 38*b*) is under the clypeus and almost entirely concealed dorsally by it. Anteriorly it is emarginate and bears several conspicuous setae. There are also many fine setae on its ventral surface.

The epipharynx (Fig. 38*b*) is a densely setose organ lying on the ventral side of the labrum.

The mandibles (Fig. 38*c*) are well developed and constructed for both cutting and crushing. The incisorial region bears two teeth posterior to the apex. The molar region is black and heavily ridged on its face. A densely setose membrane extends along the median side of the mandible from the incisorial region posteriorly to the molar region and around each side of the latter, covering the posterior face as well. The mandible bears an anterior acetabulum (preartis) which articulates with a condyle (precoila) on the ventral side of the clypeus and a posterior condyle (postartis) which articulates with an acetabulum (postcoila) on the gena. The incisorial region of the right mandible is slightly broader than that of the left, but the two are otherwise symmetrical.

The maxilla (Figs. 37*b* and 38*d*) consists externally of a cardo, stipes, palpiger, palpus, subgalea, galea, and lacinia. The arrangement of the setiferous areas of these sclerites are shown in the figures. The base of the cardo is grooved, and the dorsal side of the groove extends posteriorly beyond the level of the ventral side. This structure provides for the support and articular surface of the maxilla on the hypostomal region of the head. The groove and the dorsal extensions of the cardo are concealed when the maxilla is in its normal position. The ventral side of the cardo is thickly set with fine setae. The stipes is triangular in shape and bears a lateral longitudinal row of three large setae. The subgalea is a long sclerite on the ventral side of the maxilla median to the stipes. It is sparsely setiferous. The lacinia is small and on the dorsal and medial sides of the maxilla posterior to the galea. It bears many fine setae but no spines, teeth, or

lobes. The galea comprises the apex of the maxilla and terminates in six prominent teeth of which four are ventral and two dorsal. Its lateral margin bears a group of setae near the base. The palpifer is a long sclerite lateral to the stipes and visible on both the dorsal and ventral sides of the maxilla. It bears many large setae. The palpus is four-segmented, and there are many minute sensory papillae on its tip. The fourth segment is the longest, followed by the second, third and first in the order given.

The parts of the labium (Fig. 37*b*) are fused together, the mentum and ligula not being separated by a suture. The mentum is broader anteriorly and bears on each side near the lateral margin a longitudinal row of three large setae. There is a row of small setae along each lateral margin and a small seta in each anterior lateral angle. On the ventral surface along each lateral margin of the mentum there is a row of short striae, about eighteen per row. The sclerite here called mentum has been termed the anterior part of the submentum by Kadic (1902) and Hardenberg (1907), the mentum being considered as folded back over it. The ligula is emarginate anteriorly and bears a small seta at each anterior lateral angle. On the ventral side there are many small setae along the anterior margin, except near the mid-line, and two longitudinal rows of fine mesad-pointing setae. These rows converge slightly posteriorly. The palpigers are apparently folded under the mentum and are visible from the dorsal side only. The palpi are set in depressions and each consists of three segments of which the third is the longest, the first next, and the second shortest. The tip of the palpus bears sensory papillae similar to those on the maxillary palpus.

The hypopharynx (Fig. 38*a*) is a thickly setose triangular lobe on the dorsal side of the labium. A pair of long chitinous bars unite under its posterior end and extend posteriorly to two medially directed setose sclerites. These bars and sclerites are the fulcrum hypopharyngeum and the pharyngeal sclerites.

The tentorium is essentially as described by Stickney (1923) for *Pelidnota punctata*. The corpotentorium is a narrow dorsally-arched bridge. The metatentorium expands posteriorly around the inner edge of the occipital foramen dorsally along the acciput and ventrally along the gula. It also follows the gular suture anteriorly as a tapering lamina along its entire length. The pretentorium arises at the end of the corpotentorium and is chitinized quite strongly at its base but soon becomes a narrow membranous thread. The anterior third is, however, strongly chitinized, although not large, and terminates between the base of the antenna and the precoila. The base of the pretentorium expands ventrally and laterally almost to the mid-line as a thin laminitentorium. This extends a short distance anteriorly, tapering towards its apex.

Cervix

There are two lateral cervical sclerites on each side, one larger and anterior, the other smaller, posterior, and partly covered by the first. The anterior sclerite has a group of setae anteriorly and a few in the center. From its inner side at the anterior end a blunt projection extends into the neck cavity. The anterior end of this sclerite articulates with the head at the posterior lateral angle of the gula and its posterior end overlays the second sclerite in part. The latter projects freely from the cervical membrane and its attachment is shown by the broken line in the figure. Pos-

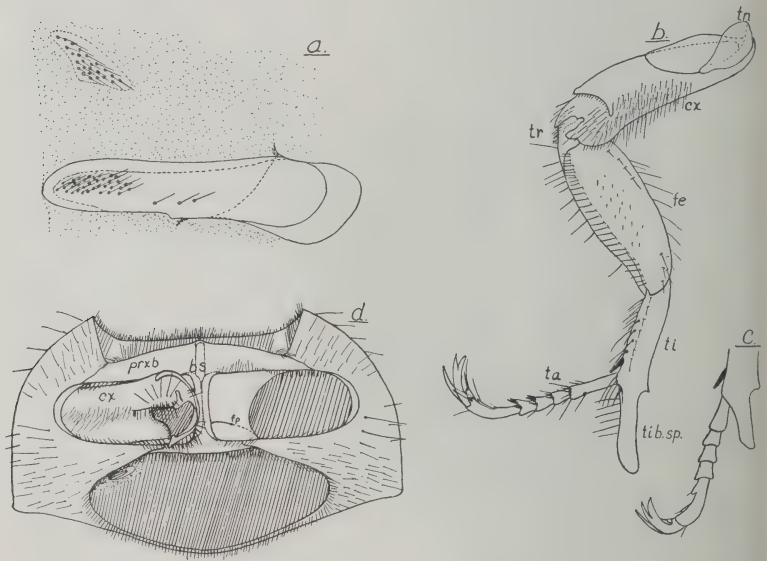

Fig. 39. a. Cervical sclerites, left side. b. Prothoracic leg of female. anterior aspect. c. Tibial spur and tarsus of male prothoracic leg. d. Ventral side of prothorax. *bs*, basisternum; *cx*, coxa; *fe*, femur; *fp*, furcal pit; *prxb*, precoxal bridge; *ta*, tarsus; *ti*, tibia, *tn*, trochantin, *tr*, trochanter. Drawings not all on the same scale.

teriorly it slightly overlaps the lateral end of the precoxal bridge of the prosternum. Dorsal to the anterior end of the first sclerite is a sub-triangular setiferous area which is not heavily chitinized.

Thorax

prothorax

The prothorax, when viewed from the dorsal side, is about twice as wide as it is long at the mid-line. The anterior margin is concave, the lateral and posterior margins convex, and the dorsal sur-

face is convex both longitudinally and horizontally. Anteriorly the prothorax is about half as wide as it is along the posterior margin. The dorsal surface is thickly punctate and bears about four small setate at each anterior lateral margin. The lateral margins are carinate. On the ventral side the pronotum extends to the precoxal bridge in front of the coxal cavities and to the sternum behind it. This part of the notum which extends on the ventral side is called the pseudopleurum by Crampton (1926). It is almost entirely covered by fine setae. The basisternum is broad anteriorly, extending laterally in the precoxal bridge, and narrows between the coxal cavities. The furcasternum comprises the posterior part of the sternum and extends laterally and dorsally in a broad shelf which is visible when the coxae are removed. This shelf bears the furcal pits. A suture separates the notum from the precoxal bridge in front of the coxal cavity, but posterior to the coxal cavity the extremity of the notum rests in a groove in the sternum and is not fused to it. The spiracle is in the membrane under the posterior ventral margin of the notum. On the ventral surface of the dorsum of the pronotum there is a short crescentic raised bar at the surface of contact of the trochantin of the anterior leg. The trochantin lies attached to the coxa at the anterior lateral margin and is not externally visible. The coxa has a crescentic ridge at its distal end on the anterior side and bears many fine setae on the lateral side. The trochanter is irregular in shape and firmly attached to the femur, articulating with the coxa. The femur is about the length of the coxa. It bears a longitudinal row of fine setae on the anterior lateral side and stronger setae along the anterior and posterior faces. There is also a longitudinal row of fine setae on the medial face. The tibia from its base to the tip of the spur is slightly longer than the femur. The spur is a prolongation of the lateral side of the tibia beyond the base of the tarsus and differs in the two sexes. In the female it is about as long as the three basal segments combined and spatulate in shape. In the male the base of the spur is wider and its length equal to the length of the basal two segments of the tarsus combined. The male spur tapers more than that of the female. The length of this spur as measured from the lateral projection opposite the base of the tarsus to the tip was for 57 females 0.87 ± 0.005 mm. and for 56 males 0.74 ± 0.004 mm. There is a longitudinal row of fine setae on the anterior face of the tibia and several more conspicuous setae along the medial face and on the inner face of the spur. There is a prominent blunt spine on the inner side of the tibia just above the base of the tarsus. The tarsus is five-segmented and terminates in a pair of movable claws. The first four segments bear terminal setae which, on the posterior side are short and spine-like. The anterior of the two claws is heavy and bifid at the tip. The posterior claw

is smaller and simple. The tarsi of the sexes differ in a few respects. The male tarsus is heavier and the bifid claw more sharply curved than that of the female. Near the base of the fifth segment of the male tarsus there is a conspicuous mesad-directed tooth. On the female tarsus this tooth is very minute. Between the bases of the claws of both sexes there projects a conical papilla bearing two apical setae. The prothoracic coxae are capable of certain degree of movement and are not rigidly attached to the thorax. They project more from the body surface than do the other two pairs of coxae.

MESOTHORAX

The mesothorax is the least developed of the three thoracic divisions of the body. The notum is a single sclerite whose anterior region represents the scutum and whose posterior part the scutellum. The latter probably comprises at least two-thirds of the entire notum. A phragma projects into the body cavity from the anterior margin of the scutum, and along the mid-line there is an internal chitinous brace which extends from the phragma a short distance along the inner side of the scutum, being externally identified by an anterior longitudinal suture. The surface of the anterior part of the notum bears many fine setae set in pits in the chitin, but the posterior surface, exposed between the bases of the elytra, is bare, although pitted. At each anterior lateral angle there is an anterior notal wing process which supports the first axial sclerite and the dorsal end of the chitinous rod (parapterum?) found along the anterior margin of the episternum. The posterior notal wing process is not prominent. The sides of the scutum are reflected ventrally and give off two processes, one directed anteriorly and the other directed postero-laterally. The former lies over the metanotum and the latter projects under the axial cord of the elytron. There are many small setae at the top of the postero-lateral process and along its posterior margin. The scutellum has a posterior reduplication which is setiferous. The posterior basal angles of the elytra fit under the lateral margins of the scutellum. The axial region bears four small chitinous plates. The shape of these is not accurately shown in the figure, as they are irregular and a three-dimensional diagram would be required to give a true picture. The first of these axial sclerites curves from the anterior notal process ventrally and posteriorly to a notch in the ventral side of the elytron. The second is approximately triangular in shape with its base towards the scutum and its apex in an incision in the base of the elytron. The third is bent at an obtuse angle and lies along the region of the axial cord. The fourth, which is small and also sub-triangular in shape, lies just posterior to the second.

The pleural region is divided by a vertical suture into an anterior episternum and a posterior epimeron. The former is divided by a diagonal line of demarcation into a darker anterior area with a few setae along its posterior margin and a posterior lighter area devoid of setae. A short wing process (a continuation of the pleural ridge) which gives support to the elytron projects from the dorsal margin of the pleuron. A carina divides the epimeron into an upper approximately horizontal region and a lower vertical region. The anterior basal angle of the elytron rests on the upper

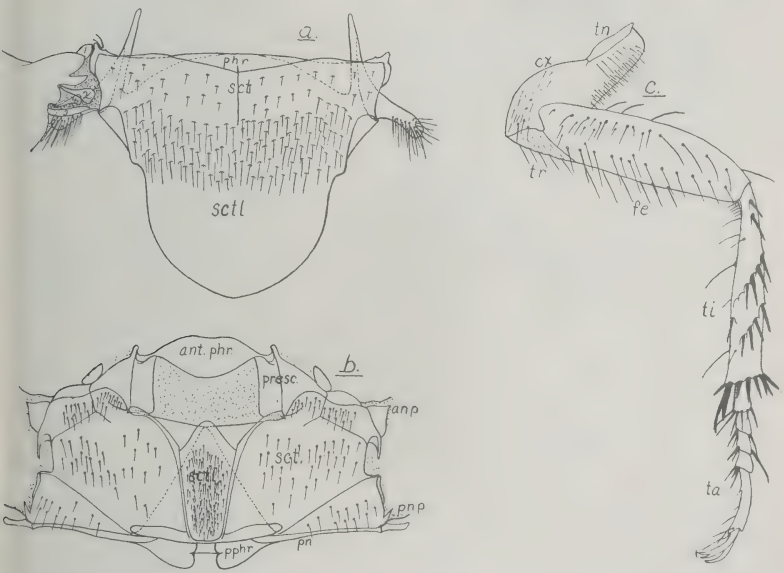

FIG. 40. a. Tergum of mesothorax. b. Tergum of metathorax. c. Mesothoracic leg, anterior aspect. The lateral scutal projections in "a" are displaced anteriorly. *anp*, anterior notal wing process; *ant phr*, anterior phragma of metatergum; *phr*, anterior phragma of mesotergum; *pn*, postnotum; *pnp*, posterior notal wing process; *presc*, prescutum; *sct*, scutum; *sctl*, scutellum; *1*, *2*, *3*, *4*, axial sclerites. For other abbreviations see figure 39. Drawings not all on the same scale.

horizontal area. The pleural coxal process extends from the ventral margin of the pleuron. Anterior to the episternum is a short, vertical rod (parapteron?) which extends to the anterior notal wing process.

The sternum is rigidly attached to the metathoracic sternum along the posterior margins of the coxal cavities. The surface is thickly set with fine setae whose bases are in shallow pits in the chitin. The basisternum extends between the pleura anteriorly and narrows between the coxal cavities. If the coxae are removed

the furcasternum, which bounds the coxal cavities medially, becomes visible, and the furcal pits are seen at the inner anterior angles of the cavities.

The legs of the mesothorax are not so strongly developed as those of the other two thoracic segments. The coxae are apparently slightly mobile, although not near so much so as those of the prothorax. The pleural coxal process forms the point of articulation of the coxa on the pleuron, and the narrow trochantin

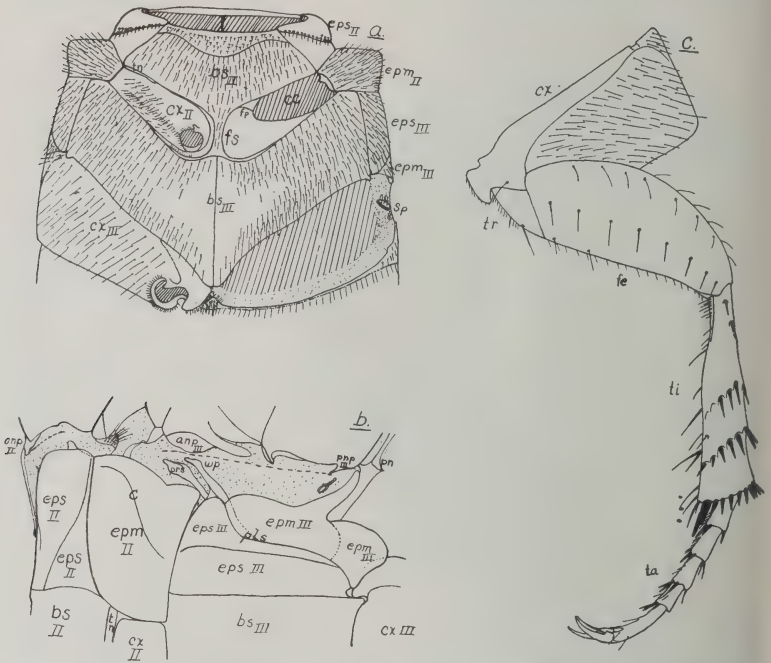

FIG. 41. a. Meso- and metathoracic sterna. b. Meso- and metathoracic pleura. c. Metathoracic leg, anterior aspect. *bs*, basisternum; *cc*, coxal cavity; *epm*, epimeron; *eps*, episternum; *fs*, furcasternum; *sp*, spiracle. The Roman numerals indicate the thoracic segments. For other abbreviations see previous figures. Drawings not all to the same scale.

lies at the inner basal angle of the coxa. The latter is about two-thirds the length of the femur and is partly covered with fine setae as indicated in the figure. The trochanter is triangular in shape and setose and is firmly attached to the femur, articulating with the coxa. The femur is the longest segment of the leg, being slightly longer than the tibia. On the anterior side there are two irregular longitudinal rows of setae and on the posterior side a longitudinal row of fine setae. The tibia bears two diagonal rows

of heavy setae on the anterior side and several small scattered setae on the posterior side. At the distal end of the tibia there are a number of short heavy spine-like setae on the anterior side, two prominent spines at the inner angle, and a few long setae on the posterior side. The anterior of the two spines at the inner angle is shorter than the posterior. The tarsus is five-segmented and similar to that of the prothorax. The claws are slightly smaller than those of the anterior tarsus and the sexes show no difference. The basal tooth on the fifth segment is small.

The elytra, when folded in repose, cover the dorsal part of the body from the anterior margin of the mesonotum to the anterior part of the pygidium except for the exposed part of the mesoscutellum which lies between their bases. There are eleven punctate striae on each elytron. The first of these striae lies close to the posterior margin (inner margin when the elytra are folded), and the second is very short. The eleventh, which lies close to the anterior margin, is also short. The anterior basal angle of the elytron is reflected ventrally to form a shelf which rests on the dorsal part of the epimeron. The posterior basal angle fits under the lateral margins of the scutellum, and the proximal part of the posterior margin fits into a groove in the metathoracic notum. The elytra meet along the dorsal mid-line except at the tips, a ridge along the margin of the left fitting into a groove in the right. The ventral side of the elytron has many fine setae on the proximal, distal, and anterior regions. The distal margin has the narrow thin membrane characteristic of the genus.

METATHORAX

The metathorax is much more highly developed than the preceding segment and its notum is more typical. The interpretation of the segment follows Snodgrass (1909 and 1927). The anterior border of the metanotum is the antecostal suture from which the anterior phragma projects anteriorly and ventrally into the body cavity. The prescutum comprises the anterior region of the notum and its heavily chitinized lateral areas are separated by a broad central membranous area which extends from the antecostal suture to the apex of the scutellum. The chitinous discs at the anterior lateral margins of the prescutum are for muscle attachment. At each anterior lateral angle of the notum is the triangular anterior notal wing process. The proscutum normally lies under the scutellum of the mesothorax. The scutum is separated into two lateral areas by a triangular scutellum whose borders are indicated by the broken line in the figure. The lateral margins of the scutum possess a pair of conspicuous indentations, and from the posterior lateral angles the posterior notal wing processes project. The axillary cords are posterior to these latter. From the anterior margin of the scutum extend the two converging parapsidal

ridges between which is the pair of longitudinal grooves for the reception of the margins of the elytra. The scutum and the region between the parapsidal ridges bear many fine setae. The scutellum is a triangular area whose base meets the postnotum and whose apex touches the posterior border of the prescutum. Its boundaries are much more clearly indicated on the inner side of the notum than on the outer. The postnotum is a narrow sclerite extending laterally to the epimeron and forming the posterior border of the notum. Beneath it the posterior phragma projects into the body cavity.

The pleural region of the metathorax is divided by a pleural suture which runs approximately diagonally, giving more of horizontal orientation to the episternum and epimeron than vertical. The episternum lies below and anterior to the epimeron and is divided into two regions by a horizontal suture. The epimeron is divided into anterior and posterior regions by a light vertical

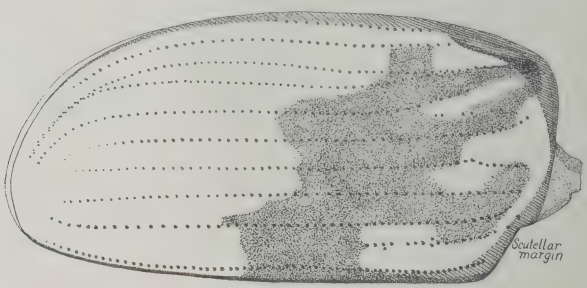

FIG. 42. Elytron.

suture. A dorsal process of the epimeron lies along the anterior margin of the lateral region of the postnotum and the postnotum meets the epimeron just posterior to the base of this projection. There are two wing processes which project dorsally from the pleuron, the anterior being the episternal parapterum which has fused to the episternum and the latter being the true pleural wing process, a continuation of the pleural ridge. On the ventral margin of the pleuron there is another inconspicuous projection of the pleural ridge which serves as a point of articulation for the leg. The metathoracic spirale lies in the membrane between the meso- and metapleuron. The pleural sclerites are setose except for the dorsal two-thirds of the anterior region of the epimeron.

The externally visible part of the sternum is the basisternum which extends between the episterna anterior to the coxa. A median longitudinal suture, which indicates the position of an internal chitinous lamella extending from furca to sternum, divides the basisternum. Except for a median nude area the basisternum is setose. At its posterior tip the sternum is inflected and to the

inflected part is attached the membrane of the first abdominal segment. From the inflected part the furca extends into the body cavity. The furcal pits are not externally visible. At the posterior lateral angles of each basisternum is the small projection which fits into an acetabulum of the coxa.

There are four axillary plates in the membrane at the base of the wing which have been numbered according to Snodgrass (1927). In addition to these sclerites there is a median plate in the median region of the wing base.

The venation of the metathoracic wing is given according to Forbes (1922), and since the veins are labeled in the figure, no further discussion is necessary here. The distal part of the wing folds under the elytra, and the folding pattern is discussed by Forbes in the paper above cited. The anterior margin of the wing bears a row of small hooks and distal to it a row of small setae.

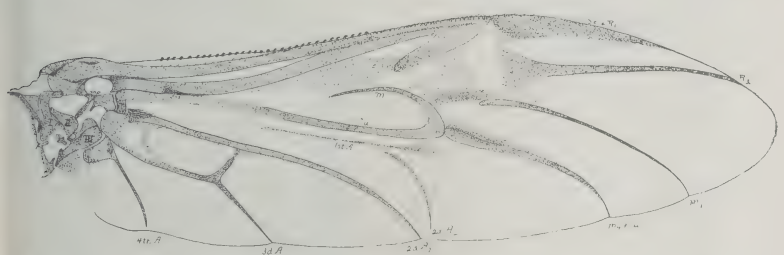

FIG. 43. Metathoracic wing. *A*, anal vein; *Cu*, cubitus; *M*, median; *R*, radius; *Sc*, subcosta; I, II, III, IV, axial sclerites.

The membraneous part of the wing anterior to the base of the costa usually folds back on it. At the base of the second anal vein there is a group of small setae.

The coxae of the third pair of legs lie rather rigidly in the coxal cavities with the anterior-ventral side in the same plane as the sternum. The anterior-ventral and posterior-dorsal surfaces are covered with fine setae. At the proximal end of the anterior margin there is a small notch or acetabulum into which a projection from the sternum fits. There is no trochantin. At its distal end the coxa terminates in a rounded "head" which projects over the triangular trochanter, and near the margin of the trochanter there is a rather large seta.

As in the case of the prothoracic and mesothoracic legs, the trochanter articulates with the coxa and is firmly attached to the femur. On its anterior side is a conspicuous seta at the inner margin.

The femur is large, approximately straight along the medial margin, and convex along the outer margin. Its anterior face is

sparsely pitted and bears two longitudinal rows of setae, one near the outer margin and one just mesad to the mid-line. There are one or two conspicuous setae on the medial margin near the base. The posterior side of the femur is smooth and nude except for a row of fine setae along the inner margin. The tibia is slightly shorter than the femur and slender. There are two diagonal rows of spine-like setae on the anterior face and a similar row along the anterior side of the apex. At the inner angle of the apex there are two heavy spines of which the anterior is slightly over half the length of the posterior. On the posterior side and along the inner margin there are several scattered setae of medium size.

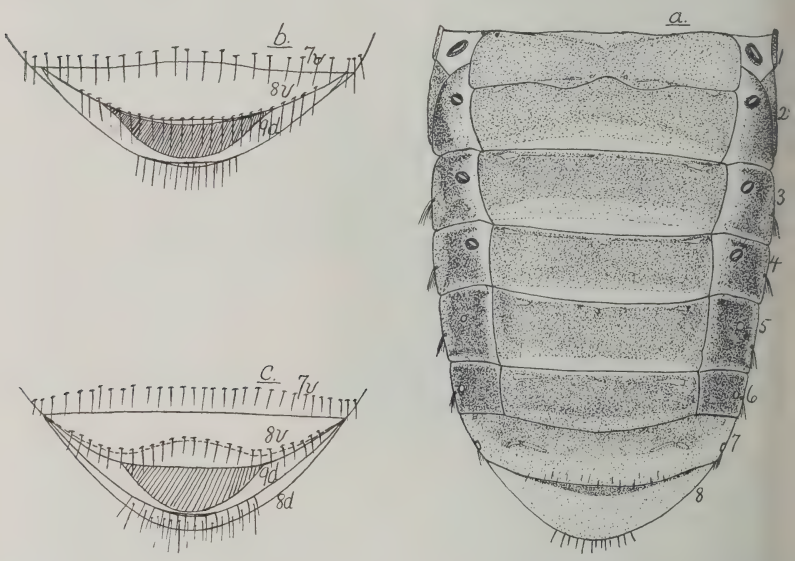

FIG. 44. Abdomen. a. Abdomen of female, dorsal aspect. v. Tip of female abdomen, ventral aspect. c. Tip of male abdomen, ventral aspect. The Arabic numerals indicate the segments. *d* signifies tergite and "*v*" signifies sternite.

The tarsus is similar to the mesothoracic tarsus in its essentials except that both claws are simple. In the other tarsi the anterior claw is bifid.

ABDOMEN

There are visible dorsally on the abdomen eight tergites and ventrally seven sternites. The first sternite is absent, and the ninth and tenth segments are concealed within the eighth. Tergites one to six inclusive are under the elytra and are weakly chitinized.

The dorsal part of segment seven is strongly chitinized and concealed beneath the tips of the elytra. The eighth tergite (pygidium) is fully exposed and the most strongly chitinized dorsal sclerite. This tergite slopes rather sharply downward to the tip of the abdomen and is slightly rugose. The tip of the abdomen

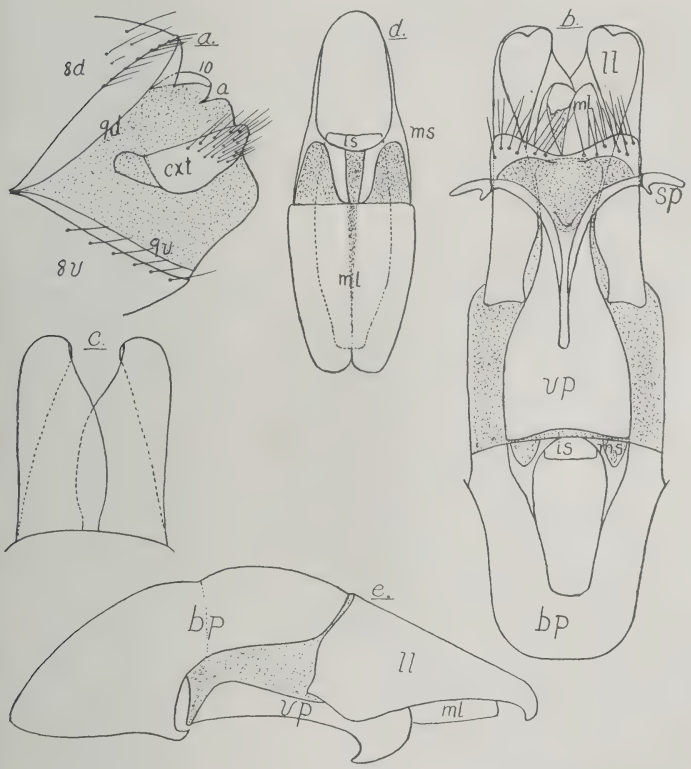

FIG. 45. External genitalia. a. Female, lateral aspect. b. Male, ventral aspect. c. Lateral lobes of male. d. Median lobe of male. e. Male, lateral aspect. *a*, anal opening; *bp*, basal piece; *cxt*, coxites; *is*, internal sac; ll, lateral lobe; *ml*, median lobe; *ms*, median strut; *sp*, spicule; *vp*, ventral plate. The Arabic numerals indicate the abdominal segment. and "d" signifies tergite, "v" sternite. The membranous parts are shaded,

bears a fringe of fine setae. The pygidium of the male tapers more sharply than that of the female.

The tergites do not all extend to the lateral margins of the abdomen, the pleural membrane being on the dorsal side in segments one to six inclusive. Segment seven is a completely chitinized

ring, but in segment eight the pleural folds are at the lateral margins.

The first sternite, as mentioned above, is absent, and the second is narrow throughout most of its width, widening at the extreme lateral regions. The anterior margin of this sternite is concealed by the metathoracic coxae and a membrane connects it to the thorax. The middle of the sternite projects forward (as the interstitial process of Verhoeff) between the ends of the third pair of coxae and a corresponding protuberance, somewhat weaker, occurs on the third sternite. This is the accessory process. Sternites four to seven are similar. The eighth sternite is convex on the posterior margin and on the female a row of setae follows this margin. On the male there is a sinuate carina on the eighth sternite and a row of setae follows this carina. On sternites two to seven inclusive, there is a median horizontal row of setae. The ninth sternite is partly chitinized but concealed by the eighth. The tenth segment is represented by the membrane surrounding the anus and in the female there is a well chitinized proctiger above the arms. The sternum of the female is convex longitudinally, but that of the male is straight or slightly concave.

There are seven pairs of spiracles on the dorsal side of the abdomen but lateral to the line of the pleural membrane. These occur on segments one to seven inclusive. The first pair occur in a small membranous area which, if the spiracles are on the morphological sternite, should be considered part of the first sternite. These are the largest spiracles of the abdomen. The last three pairs of spiracles are small and diverge posteriorly.

The genitalia are withdrawn into the abdomen. In the female there is a pair of coxites below the anal opening and lateral to the genial opening. The male genitalia consist of an anterior large basal piece, a ventral plate, two lateral lobes, and a median lobe which contains the true penis or inner sac. On the ventral side below the lateral lobes is a Y-shaped sclerite, the spicule. The lateral areas of the anterior part of the median lobe are chitinized to form the median struts. The inner sac is evaginated during copulation and is directly connected with the ejaculatory duct which passes under the basal piece. The ventral distal part of the inner sac is chitinized and the proximal part is spinose. The median lobe lies between the paired lateral lobes and the ventral plate. Its lateral regions are chitinized. The genitalia of the male have been named according to Sharp and Muir (1912) and those of the female according to Tanner (1927).

The Egg (Plate xviii)

When first laid the egg is white, ovoid, smooth, and measures about 1.2 mm. × 1.5 mm. After being in the soil a few days it swells and becomes more nearly spherical in shape. The following measurements of eggs of different ages indicate the relative size.

Table 4—Dimension of Eggs

No. of eggs	Maximum width mm.	Maximum length mm.	Age
10	1.19 ± .002	1.51 ± .002	When laid.
	1.54 ± .013	1.82 ± .009	Same eggs after 10 days at 24° C.
7	1.59 ± .021	1.91 ± .043	13-15 days at 24° C.
8	1.58 ± .024	1.96 ± .041	Large eggs collected in the field.

It is essential that a certain amount of moisture be present to enable the eggs to develop. Under air-dry conditions they do not swell but dry out and die. The total period of incubation at 24° C. is 17 days, so the last two lots of eggs given in the table represent very nearly if not actually the maximum size. A photograph of the eggs is shown on Plate XVIII.

The Larva (Plate xviii)

There have been published in recent years the description of the larvae of several Ruteline beetles fairly closely related to *Anomala orientalis*. Böving (1921) gave a systematic and morphological study of the larva of *Popillia japonica* and *Pachystethus lucicola*, and Hayes (1927) described the immature stages and larval anatomy of *Anomala kansana*. Rittershaus (1927) published an account of the biology and morphology of *Phyllopertha horticola* and *Anomala aenea*, giving particular attention to the genitalia. In the following description, mention is frequently made of the setal arrangement, for the determination of the species may be more easy if the setal pattern is known.

There are three larval instars, and these conform to the Ruteline type. When first hatched the larva measures about four millimeters in length. During the first instar it attains a length of about eight millimeters. The second instar attains a length of about 15 millimeters, and the fully grown larva is 20-25 millimeters long. The following table gives the width of the head capsule measured at the widest part (just behind the antennae). Although there is some variation in this within each instar, it is not great enough to cause any confusion in the determination of the instar by measuring the head capsule.

When first hatched the larva is white except for the tips of the

mandibles, the egg burster, and some of the setae, these being brown. The head soon darkens to a light brown color and the body darkens, due to the filling of the intestines when feeding

TABLE 5—WIDTH OF HEAD CAPSULE OF LARVA

No. of larvae	Instar	Width of head	
50	1st	1.15 ± .01 mm.	Measured day of hatching.
21	1st	1.19 ± .01	Preserved specimens from miscellaneous collections.
29	1st	1.17 ± .06	Preserved specimens not over 24 hours old when killed.
17	2d	1.96 ± .08	Preserved specimens from miscellaneous collections.
8	2d	1.81 ± .02	Measured 73-75 days after hatching. Reared in sod compost at 24°-25° C.
18	3d	3.07 ± .12	Measured 93 days after hatching. Reared in living turf at 24°-25° C.
20	3d	2.97 ± .03	Preserved specimens from miscellaneous collections.
7	3d	2.80 ± .04	Measured 116-118 days after hatching. Reared in sod compost at 24°-25° C.

begins. In the following description, the third instar was used, but the other two instars are essentially the same except for size, and where they differ in any important detail, this is noted in the description.

HEAD

The head is slightly longer (from occiput to anterior border of labrum) than broad. There are no ocelli but the antenna and mouth parts are all well developed.

In the *epicranium* the Y-shaped epicranial suture extends from the occipital foramen to near the bases of the antennae where the arms become indistinct. The stem of the suture is about half the length of the frons. This stem is slightly thickened and from its inner side a tendon extends into the head cavity. The sides of the suture along the stem are very slightly if at all raised. The vertex is smooth and divided symmetrically by the epicranial suture. It extends laterally and posteriorly to the occiput. On the dorsal side the vertex bears a number of setae (Fig. 46). Along each side of the spicranial suture is a row of about seven setae extending from near the occiput to about opposite the middle of the frons. The number of setae in either row varies from five to eight in the all three larval instars. Between the end of this row of setae and the base of the antenna on each side is a group of two setae ("2" Fig 46.), which are constant and conspicuous, and there are numerous setae along the lateral sides of the vertex, the largest and most conspicuous of which are one

near the base of the antenna ("1" Fig. 46) and one about midway between the occiput and antennae ("3" Fig. 46).

The *occiput* (Fig. 47) surrounds the occipital foramen laterally and dorsally. It is separated laterally on each side from the vertex by a suture and anteriorly from the postgena by another suture. The maxillariae, to which the cervix is attached, almost completely cover it. These are thinly chitinized sclerites which are folded back flatly against the posterior side of the head. Each bears near

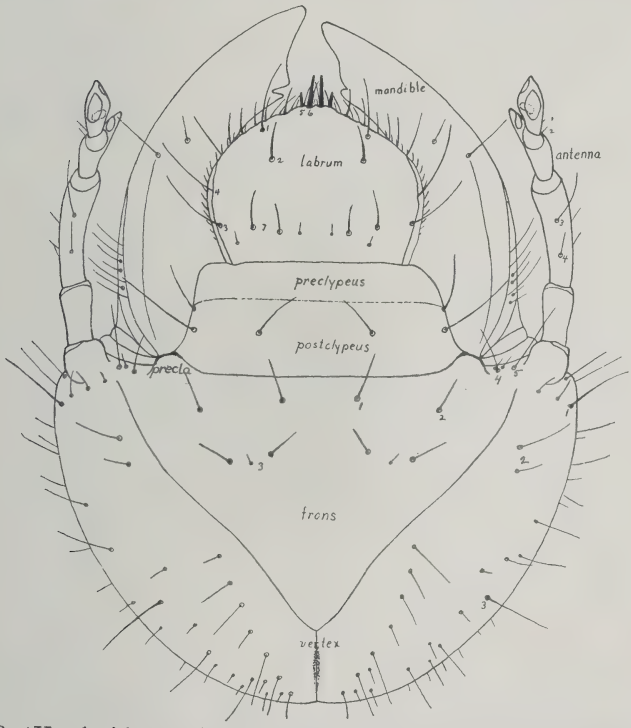

FIG. 46. Head of larva, dorsal aspect. The groups of more conspicuous and constant setae are numbered.

its latero-ventral angle a heavily chitinized point of articulation with the cervical sclerite of that side. This point of articulation is the odontoidea.

The *postgena* is more or less triangular in shape and separated from the occiput and gena by sutures. It bears at its median anterior angle the point of articulation with the maxilla, the paracoila or cardocondyle.

The *gena* is an area bordering the anterior lateral angle of the vertex and is found on the ventral side of the head capsule. It

bears on its anterior margin the posterior point of articulation with the mandible, the postcoila. This is an acetabulum. There are several setae in the posterior part, two of which ("1" and "2" Fig. 47) are conspicuous and constant in position. The remainder are small and about eleven in number.

The occipital foramen is divided by a *tentorium* (Fig. 47) beneath which pass the nerve cords from the thoracic ganglion and above which passes the alimentary tract. The parts of the tentorium are probably as follows: The body (bt) constitutes the

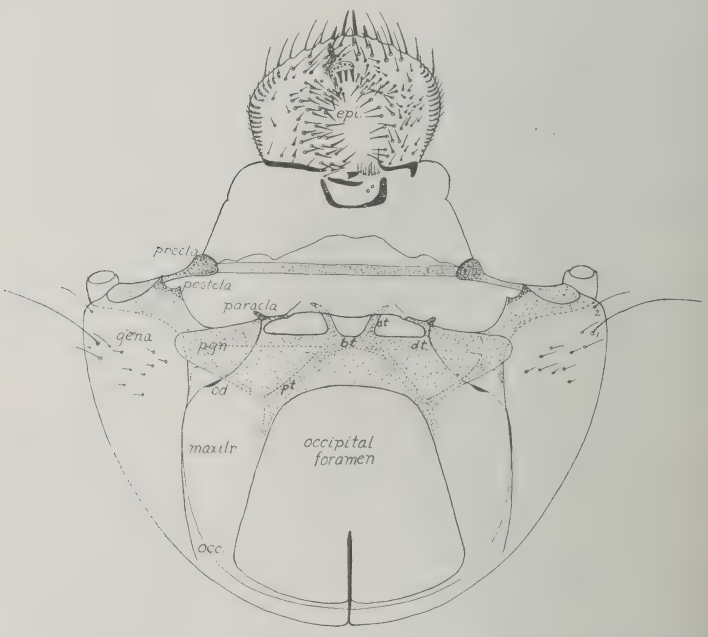

FIG. 47. Head of larva, ventral aspect, mandibles and maxillae removed. *at*, *bt*, *dt*, and *pt*, parts of tentorium. *epi*, epipharynx; *maxilr*, maxillaria; *occ*, occiput; *od*, odontoidea; *paracla*, paracoila; *pgn*, postgena; *postcla*, postcoila; *precla*, precoila.

main part and divides the occipital foramen. The arms are represented by the thickenings marked "at" (anterior), "pt" (posterior), and "dt" (dorsal). The dorsal arms continue as thickenings of the capsule along the line of attachments of the maxillae and mandibles and the posterior arms extend back to the border of the foramen. The anterior arms extend forward slightly into the head cavity. A chitinous "brace" connects the dorsal and posterior arms, and a thin chitinous sheet connects the body of the tentorium with the posterior arms. The tentorium is not well

developed, and all the parts here described may not be homologous with those of the adult.

The *frons* (Fig. 46) occupies the region between the arms of the epicranial suture and the fronto-clypeal suture, being triangular in form. There are several small pores scattered over its surface, and it bears several prominent setae. On the anterior part are six setae constant in position and present in all instars. Of these six one pair is close to the anterior margin and near the mid-line ("1"). Lateral and somewhat posterior to each of this pair is another seta ("2"), about midway between "1" and the epicranial suture. Between the base of the antenna and the precoila on each side are two large setae ("4" and "5") and one or two minute setae. In the middle of the frons are four large and constant setae, one pair each side of the mid-line ("3") and there is frequently a minute seta associated with each of these pairs. The frons bears near each lateral anterior angle the anterior condyle on which the mandible articulates, the precoila.

The *antennae* are four segmented and each is borne on a conical projection of the vertex. The first segment is short and bears no setae. The second is the longest of the four and bears two dorsal setae ("3" and "4" Fig. 46) and three or four ventrally. The third segment is short and terminates in a short conical projection on the inner side. There are two setae ("1" and "2" Fig. 46) on its ventral side. The conical spur on the median side of the distal end bears an oval sensory area on its outer surface. The fourth segment is conical and bears no setae. There are three sensory areas present on this segment, one large and oval in shape on the dorsal surface, one small and more or less quadrangular on the ventral surface, and one small and oval on the inner surface near the apex (Fig. 46). The ratios of the length of the segments has been used by Böving in describing Ruteline larvae and for the third instar of *A. orientalis* are approximately as follows: Subapical to basal segment 1:1; apical to basal segment 1.3:1; total length to basal segment 5:1.

The *clypeus* (Fig. 46) is approximately rectangular in shape and a little over twice as wide as it is long. It is divided into an anterior membranous preclypeus and a heavily chitinized postclypeus, but there is no dividing suture. The post-clypeus has a slightly rugose surface which contains many scattered "pores" and bears six prominent setae, one each side of the mid-line near the base, one each side near the middle of the lateral margin, and one at each anterior lateral angle. The preclypeus is asymmetrical, the left anterior angle being more prominent than the right.

The *labrum* (Fig. 46) is asymmetrical as shown in the figure. The dorsal surface is rugose and contains many "pores". There are eight prominent setae on the disc, two near the anterior margin ("1"), two a little anterior to the center ("2"), and four ("7")

near the posterior margin. The latter are grouped in two pairs, one pair each side of the mid-line, and close to each pair there are usually one or two minute setae. On each side of the labrum and on the posterior half are two large setae ("3" and "4"), the anterior of which is in a groove which runs longitudinally along the side. At the tip of the labrum are four heavy setae of which the outer two are about one-half the length of the inner two. Along each side and posterior to these apical setae is a row of about five setae. The setae around the edge of the labrum are set in slight depressions, which gives a crenulated appearance to the margin. The central setae ("2") on the disc are set in deep depressions, and the posterior setae ("7") in slight depressions.

The *epipharynx* (Fig. 47) has been described by Hayes (1928). It covers the ventral side of the labrum and is devoid of setae in the center. On each side of this nude area are several short heavy setae arranged in three more or less regular rows and all pointing centrally. Lateral to these are several very small setae. Anteriorly is a small papilla (distal sensory area) bearing three spines and, just anterior to the spines, a transverse row of eight or nine "pores." The area between the papilla and the tip of the labrum is covered with setae and contains a shallow longitudinal depression which extends from the right side of the papilla to the anterior margin of the labrum. Extending medially from each posterior lateral angle of the labrum and on the ventral side is a narrow chitinous plate, the torma. The one on the left curves anteriorly at its apex and posteriorly at its base. The right one is nearly straight. Between these lines a short conical chitinous papilla (sensory cone), and posterior to this cone is a heavily chitinized narrow transverse plate which is attached at its lateral end. Between the cone and the left torma is a transverse row of very fine short setae. Still further posteriorly is a lightly chitinized U-shaped band and two pores (clypeal sensillia). These structures posterior to the tormae are really on the ventral side of the clypeus. On the lateral side and extending from the posterior margin about two thirds of the distance to the apex is a row of chitinous striae, about 16 in number, each of which is accompanied by a small seta at its outer end (Fig. 47). The tips of the setae of these two rows are visible from the dorsal side.

The *mandibles* (Fig. 48*a*) are asymmetrical, the right being more acutely pointed than the left, having a shallower incision separating off the dentes, and having a differently constructed molar region. The tips of the mandibles and the molar regions are black, the remainder brown. The incisorial edge (gnathapex) of each mandible is slightly concave with one dentes (gnathodentes) posteriorly. On the dorsal surface of the mandible and about one-third the distance from the apex to the base is a conspicuous seta, and lateral of this is another larger seta. The base of the

mandible is three-sided. The outer face bears a longitudinal ridge ventral to which is a group of about seven setae and dorsal to which is a row of about ten pores. In the first and second instars, however, this face is smooth, although the setae are present. The ventral face bears a more or less oval stridulatory area of transverse ridges. These areas are similar in shape on each mandible (Fig. 48*a*). The outer basal angle of the ventral surface of each mandible bears a group of about five very small setae distal to the posterior condyle (postartis). This condyle articulates in an acetabulum (postcoila) on the gena. The anterior (or dorsal) articulation is by means of an acetabulum (gnathacetabulum or pre-artis) on the anterior dorsal face and a condyle (anterior condyle or precoila) at the posterior lateral angle of the clypeus. The inner posterior (proximal) part of the mandible is the molar region. This has been figured for two species of Scarabeidae by Böving and its structure used to distinguish them. The molar regions of the mandibles meet the hypopharyngeal chitinization as well as each other. On the ventral side of each mandible and close to the molar region is a lobe which meets the hypopharynx. The right molar region consists of four granulose surfaces separated by grooves. The distal three constitute the crown (according to Böving) and the proximal one the heel or calyx. The first lobe of the crown (cr) is in some specimens oval and is so drawn, but in many specimens of all instars it is very irregular. The other two lobes of the crown (cr_2 and cr_3) are elongate and curved, and the heel or calyx (ca) is flat, approximately oblong and about twice as broad as long. The dorsal posterior angle of the heel extends as an obtuse conical projection, and the posterior side of the face is not parallel with the distal but slopes in slightly toward the distal side. The proximal side of the molar region of the right mandible bears a dorso-ventral row of setae. The left molar region is projected medially at the anterior end, this projection meeting the sinuate upper part of the hypopharyngeal chitinization. The inner face of the molar region bears two anterior incised rugulose surfaces and a posterior smooth sub-triangular area. Projecting from the dorso-anterior angle of this latter area is a membranous lobe (hamus) from the apex of which runs a row of setae which extends around the posterior margin of the molar region. The dorsal and outer surfaces of the mandibles are rough, but the ventral surface, except for the stridulating area, is smooth. The exterior tendon of each mandible is attached along the posterior edge of the outer face, and the flexor tendon is attached along the posterior edge of the molar region. A membranous area (trochantin of the mandible) lies between the base of the mandible and the base of the antenna.

The *maxillae* (Fig. 48*d* and *e*) are paired structures articulating

with the head capsule by means of an acetabulum (parartis) on the basicardo and a condyle (paracondyle) on the postgena. The galea and lacinia are fused into one conical lobe, the mala, the outer part representing the galea and the inner the lacinia. Along the medial side and near the apex of the lobe are three fixed

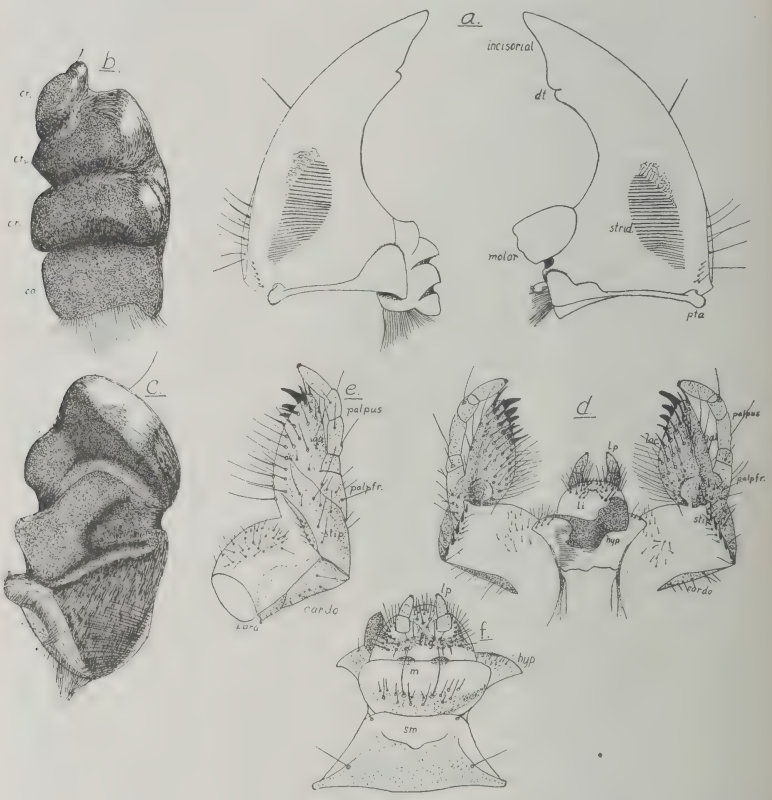

FIG. 48. Mouth-parts of larva. a. Mandibles, ventral aspect. b. Molar region of right mandible. c. Molar region of left mandible. d, Maxillae, dorsal aspect. e. Left maxilla, ventral aspect. f. Labrum, ventral aspect. *ca*, calyx, or heel; *cr.*, cr_2, cr_3, crown of molar of mandibles; *dt*, tooth of mandible; *gal*, galea; *hyp*, hypopharynx; *lac*, lacinia; li, labium; *lig*, ligula; *lp*, labial palpus; *m*, mentum; *paplfr*, palpifer; *pta*, postartis or posterior condyle of mandible; *sm*, submentum; *stip*, stipes; *strid*, stridulating area of mandible.

large spines in a longitudinal row, the largest of the three being the anterior and the smallest the posterior. On the dorsal side of the lobe are three more or less parallel rows of setae running obliquely across with a few scattered setae (about seven) posterior

to them. The anterior of these three rows contains seven heavy setae, the next row eight more slender setae, and the posterior row about five slender setae. There are several short setae at the lateral basal angle of the lobe on the dorsal side. On the ventral side of the lobe is a longitudinal row of about six setae. Anterior to this row and at the apex are two heavy setae, and other setae are found as indicated in the figure. There are a few setae on the ventral side on the stipes and on the base of the palpifer. A small elongate sclerite medial to the stipes is the parastipes. It bears a row of about five minute setae. On the dorsal side of the stipes is a row of from five to seven (usually five or six) strong anteriorly directed hooks which comprise the maxillary part of the stridulatory apparatus. These rub against the corrugated area on the ventral side of the mandible. The cardo is divided into two sclerites, a basicardo and a much larger disticardo, both of which bear a few setae. The basicardo bears the acetabulum (parartis) of the maxilla. On the dorsal side the proximal part of the maxilla is membranous and bears many minute setae. On the ventral side this proximal region has a chitinized area bordering the cardo and a lightly chitinized setiferous area medially. The maxillary palpus is four-segmented and is borne on a projecting palpifer. The palpifer is setiferous and there is one seta on the ventral side of the first segment of the palpus, one anteriorly on the ventral side and one laterally on the second, two on the third placed similarly to those on the second. The apex of the fourth segment bears a number of minute sensory papillae. The relative lengths of the segments from basal to apical consecutively bear the following ratio, approximately: 1:2: 1.5: 2.5 (in the third instar). The relative lengths of these segments varies a little in the other instars, but the basal segment is always the shortest, the sub-apical next, the second segment next, and the apical segment longest.

The parts of the *labium* (Fig. 48*f*) are fused into a single structure. The submentum is approximately trapezoidal in shape and well chitinized over the basal two-thirds. There are four setae present, one large seta near each basal angle and one small seta in each apical angle (these latter are absent in the first instar). The mentum is broader at the apex than at the base and is much wider than long. It bears a chitinous band across its base on which are one pair of prominent setae near the mid-line and between and lateral to them several smaller setae. In the first instar there is only one small seta present lateral to the large setae. The ligula, representing the fused distal parts of the labium, is approximately conical with a pair of palpi borne on the ventral side near the apex. Near the mid-line and on the posterior border of the ligula are two small oval chitinous areas. The area around the base of each palpus on the ventral side is

heavily chitinized and setiferous, and the tip bears many setae. A little dorsal to the apex of the ligula is a depression with a pore in its center. The palpi are two-jointed and the apex of the terminal joint bears a number of minute sensory papillae.

The *hypopharynx* (Fig. 48*d*) lies on the dorsal side of the labium. Its anterior part is asymmetrical and heavily chitinized, projecting anteriorly on the right side, the hypopharyngeal chitinization of Böving. Against this chitinization the molar regions of the mandibles act, the anterior part of the left molar meeting the left side of the anterior projection of the chitinization. There is a group of small setae at each anterior angle of the hypopharynx and a row (approximately longitudinal) of setae on each side of the base of the chitinization. The left row is longer and curves medially at its anterior end. The right row is short and follows the edge of the chitinization. The sides of the hypopharynx as it passes into the pharynx are slightly chitinized.

Cervix

The most important part of the cervix consists of the sclerites, not separated from the rest of the cervical region by sutures, which extend from the episternum of the prothorax to the maxillariae, forming a support for the head, one sclerite on each side. The remainder of the cervix is membranous and devoid of setae except in the mid-ventral region where a group of setae belonging to the prothorax extends upon the cervical membrane.

Thorax

On the dorsal side the thoracic segments are divided into annulets. There are three of these on each segment, but the division between the first two of the prothorax is very faintly indicated. Figure 49 is a diagram of the body of a third instar larva and shows these annulets and the setal arrangements. The thoracic segments are indicated by Roman numerals. The third annulet of the prothorax and the second annulet of the meso and metathorax are devoid of setae, but the other annulets are setiferous.

There are certain setiferous areas laterally on the thorax, these areas being on slight protuberances of the integument (Fig. 49). On the prothorax these areas, except for one on the posterior-ventral angle of the pleuron, are poorly defined. On the meso- and metathorax there are on each side four such areas, one between the second and third annulets; one, circular in out-line, ventral to the first and between the ends of these annulets; two smaller, ventral to the second.

The prothorax bears a pair of spiracles (these belong phylogenetically to the mesothorax) close to the posterior margin,

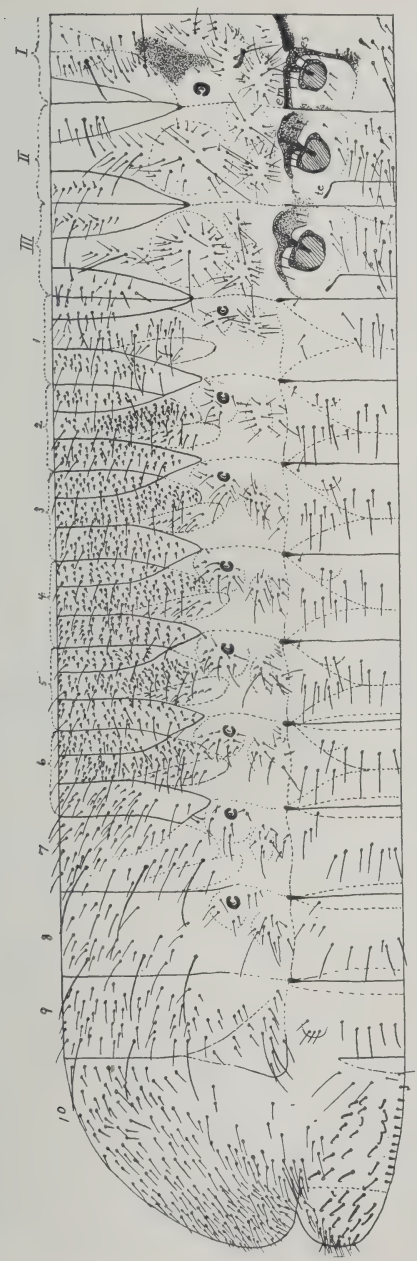

FIG. 49. Diagram of larva right side, head and legs removed. The upper margin represents the dorsal mid-line and the lower margin the ventral mid-line. The Roman numerals indicate the thoracic segments, the Arabic numerals the abdominal segments; *em*, epimeron; *es*, episternum; *le*, tendon.

these being the only thoracic spiracles. The respiratory plate (peritreme) of the prothoracic spiracle opens posteriorly, the reverse of the abdominal spiracles which open anteriorly. In the first instar the respiratory plate is relatively larger than in the other instars and the central part of the spiracle relatively small and more triangular than oval in shape. The prothoracic spiracle is the largest on the body, the seventh and eighth abdominal spiracles next in size, the second to sixth inclusive abdominal next, and the first abdominal is smallest. In the center of the respiratory plate is the bulla. The arrangement and shape of the holes of the respiratory plate have been used by Böving, following Schiödte, as systematic characters of importance. The genus *Anomala* is described as having these holes arranged in transverse rows and oblong in shape in contradistinction to irregularly arranged and angulate-rotundate in shape. In *Anomala orientalis* these holes are only approximately as described for the genus *Anomala* but are more nearly so than irregularly arranged and angulate-rotundate except in the first instar where they conform to the latter description. A photograph of a spiracle is shown on Plate XVII.

There are on the pleuron of the prothorax two chitinous plates near the spiracle (not distinct in the first instar, however). One of these is relatively large and dorsal and anterior to the spiracle. The other lies ventral and anterior to the spiracle and is a small bar. Just above it is a conspicuously large seta.

Each thoracic segment has two small sclerites lying just above the coxal cavity and separated by a perpendicular suture. A phragma projects into the body cavity from this suture. These sclerites are the episternum (es) and epimeron (em) and at their junction they project ventrally to form a condyle for the articulation of the coxa. The prothoracic sclerites are longer and narrower than those of the following two segments. The prothoracic episternum forms a shoulder for the articulation of the cervical sclerite and then extends ventrally in front of the coxal cavity. The epimeron of this segment extends back to the mesothorax. On the meso- and metathorax the sclerites are broader but not as long. On all three segments both of these sclerites bear two to four small setae.

On the ventral side of each thoracic segment there is a median group of rather large setae and a few smaller setae lateral to it. The meso- and metathoracic segments each have a light curved transverse fold in the integument anteriorly and a straight linear transverse ridge posteriorly. This latter is internal and serves for muscle attachment. It also bears at each end a short tendon (te) to which is attached a muscle from the middle of the pleuron.

In the first larval instar there is present on the middle of the metathoracic pleuron on each side the egg-burster. This has

been very well described as to form and function for other Scarabaeidae by Rittershaus (1927). It consists of a conical sharply pointed protuberance bearing a slender pointed spine on the posterior side of the apex (Fig. 50*c*) and serves as a point for the application of pressure from within when the larva breaks the egg chorion in order to hatch. It does not act as a means of cutting the chorion. This egg-burster is cast off at the first molt.

The thoracic legs are illustrated in Fig. 50*a*. Those of the prothorax are shortest and those of the metathorax longest. This difference in length occurs mainly in the coxa, although the more terminal part (except the tarsal claw) also shows a progressive increase in length from prothorax to metathorax. Each leg is composed of five segments, coxa, trochanter, femur, tibia-tarsus

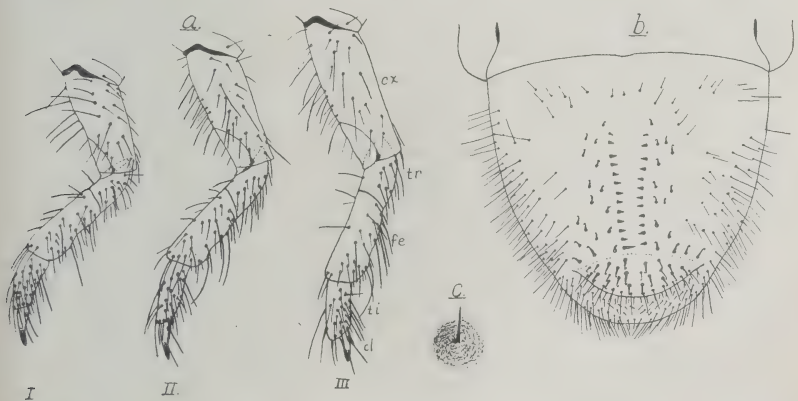

FIG. 50. a. Larval legs, all drawn to the same scale. b. 10th abdominal segment of larva, ventral aspect. c. Egg-burster of larva. *cl*, tarsal claw; *cx*, coxa; *fe*, femur; *ti*, tibia-tarsus; *tr*, trochanter. The Roman numerals indicate the thoracic segments.

and tarsal claw. The principle articulations of the leg occur at the coxa-pleuron and coxa-trochanter joints, and in the prepupal stage the legs are folded at the latter joint. The proximal edge of the coxa bordering the thorax is heavily chitinized anteriorly where the coxa articulates on the thoracic sclerites (Figs. 49 and 50*a*), but this chitinization diminishes on each side and is practically absent posteriorly. All the leg segments except the tarsal claw bear numerous setae, but the claw bears two only, one on the median side and one on the postero-lateral side. This claw is heavily chitinized at the tip but quite fleshy proximally. The third tarsal claw is much shorter than that of either the meso- or prothorax, a character used in distinguishing *Anomala* from allied genera (see Böving 1921).

Abdomen

There are ten visible abdominal segments of which the first six are divided on the dorsal side into three annulets each, but the last four are simple. These annulets tend to confuse the limits of the segments, but Figure 49 shows what appears to be correct according to the internal muscle attachments. Each annulet of the first six segments except the first of segment one and the third of segment six bears a transverse row of fairly prominent setae posteriorly and a large number of very short spine-like setae, the general arrangement being similar on the corresponding annulet of each segment. In the two excepted annulets the setae are irregularly arranged. The usual number of setae on the anterior annulet is about ten, on the median annulet about eighteen, and on the posterior annulet about fourteen. On the seventh, eighth and ninth segments the dorsal side bears no short spine-like setae and each segment has a transverse row of six very large setae near the posterior margin. Many smaller setae are also present. The dorsum of the tenth segment is thickly set with small setae of varying lengths. In the first instar, the abdominal setae are longer in proportion to body size than in the other instars, and the setae comprising the horizontal row of the second annulet of segments one to six are longer than the corresponding setae on the other annulets of the same segment.

Laterally each abdominal segment from one to six inclusive bears an oval setiferous area between the ends of the second and third annulets. This area is very faintly indicated on segment seven. In each segment from one to eight inclusive there is a more or less circular setiferous area around the spiracle and ventral to this an approximately oval setiferous area. On the ninth segment there is a triangular setiferous area on each side, the ventral margin of this area being the line separating the ventral and pleural regions of the segment. All these setiferous areas are protuberances or folds of the integument. At each end of the anal slit on the tenth segment is a small group of setae which are somewhat longer than those on the dorsum. There are eight pairs of abdominal spiracles, one pair on each of the first eight segments. The respiratory plates of these spiracles open anteriorly, the reverse of the thoracic spiracle, and those of the first instar differ from those of the other two instars as mentioned above (page 624).

The ventral side of each abdominal segment (Fig. 49) except the tenth bears an irregular transverse row of setae and a few other setae laterally. The intra-segmental folds of the integument are shown by dotted lines in the figure. On the ventrum of the ninth segment there is a conspicuous setiferous protuberance laterally. The ventral side of the tenth segment bears two nearly parallel rows of very short, heavy, spine-like, recumbent setae

which point mesad. The number of these setae varies and is not usually the same in both rows on one individual. There may be as few as ten and as many as sixteen in either row, and there may be as many as three more in one row than in the other. The number found is usually between eleven and fourteen. There is frequently a slight tendency for these rows to diverge anteriorly. This structure is frequently used in identifying Scarabaeid larvae, since it is relatively constant in one species and varies much among species but it alone cannot be relied on, since both *Phyllopertha horticola* (see Rittershaus 1927) and *Pachystethus lucicola* (see Böving 1921) have a similar arrangement and may have the same number of setae in some cases. In *Anomala orientalis* the distance between the border of the anal opening and the posterior end of the two rows is about half the length of the rows. There are several strap-like setae with hooked ends on each side of the central rows and between the anal opening and the posterior ends of the rows. The anal opening is bordering by fine setae similar to those found on the dorsum and is crescentic in shape.

The Prepupa (Plate xix)

The prepupa does not represent a morphologically distinct stage in the development of this insect but is merely a quiescent period which terminates the third larval instar. The larva is in the third instar but is not active. The legs are folded at the coxa-trochanter joint and are useless. The intestine is evacuated and the body of the larva appears creamy white in color.

The Pupa (Fig. 51 and Plate xix)

The pupa (Fig. 51) is about 10 mm. long, about 5 mm. in greatest diameter, and light brown in color. There are many fine setae on the legs, antennae, and dorsal surface of the body, and the caudal end of the abdomen bears a thick fringe of setae. The entire body is covered with a very fine pubescence.

On the ventral side all the mouth parts and the thoracic appendages are distinct. The epicranial suture is evanescent, and the vertex and frons are fused together. The eyes are partly concealed by the bases of the antennae. The antennae border the mouth parts laterally and are indistinctly divided into three lobes. The clypeus is trapezoidal in shape with a slightly sinuate posterior margin (fronto-clypeal suture). The labrum is asymmetrical, being slightly larger on the left side than on the right, and slightly inflexed at the tip. The mandibles are crescentic and border the clypeus and labrum laterally, being partly concealed by them. The maxillae project from beneath the mandibles and each consists of one lobe to which is attached laterally an indis-

tinctly segmented palpus. The labial palpi touch each other at their tips and lie transversely across the base of the conical labium. Figure 51 is a diagram of a young pupa. Near the close of the pupal period the mouth parts become more inflexed and differ slightly in appearance from the diagram. The lateral areas of the pronotum border the eyes and antennae. The thoracic legs are folded so that medially the tip of the coxa and the base of the femur are visible beneath the tibia and tarsus. On the prothoracic legs there is a short spur at the outer apical angle of the tibia, and on the mesothoracic and metathoracic legs there are two spurs at the inner apical angle of the tibia. The former represents the tibial spur of the adult, whereas the latter represent heavy fixed spines. The anterior tarsi have the segments very slightly indicated, but the segmental divisions are a little more clearly shown on the mesothoracic tarsi, and they are quite distinct on the metathoracic tarsi. The tips of the anterior legs extend well into the posterior half of the metathoracic sternum, and the tips of the mesothoracic legs extend to about the middle of the third abdominal segment. The metathoracic legs extend to the ninth abdominal segment in the male and to the eighth in the female. The wings lie between the second and third pairs of legs. The mesothoracic wings cover those of the metathorax except at the tips and along the medial margin. The anterior wings are very faintly ridged. Between the first and second coxae there is a very small part of the mesothoracic sternum visible, but posterior to the second coxae the visible part of the metathoracic sternum is quite large.

The ventral side of the abdomen differs in the two sexes. The first eight visible segments are similar in each sex, but posterior to the eighth visible (the ninth true abdominal segment) are the anlagen of the adult genitalia in the male. The first abdominal segment is not visible ventrally, and the second is almost entirely covered by the thoracic appendages. Segments three to nine are distinct. Three to six inclusive are about equal in length, but seven and eight are wider than those preceding, and the ninth is a very narrow band about one-third (female) to one-fourth (male) the width of the eighth. Laterally there is a pleural fold along the length of the abdomen which is very prominent on segment eight and posteriorly. Posterior to the ninth segment of the male there are two lobes, the anlagen of the parameres (lateral lobes), and posterior to this the anlage of the penis. This latter is partly divided by a suture representing the future ejaculatory duct. The abdomen of the male is more slender than that of the female. The external genital opening lies in segment nine. The visible area posterior to the genitalia of the male is the dorsal part of segment ten.

Dorsally the two sexes are alike. The pronotum is similar in shape to that of the adult. The mesonotum is about equal in

width to the metanotum and about one-half again as broad as long. The metanotum is about twice as broad as long and about half as long as the pronotum. The suture separating the meso- and metanotum is convex posteriorly. The wings of each segment are indistinguishably fused with the notum. There are

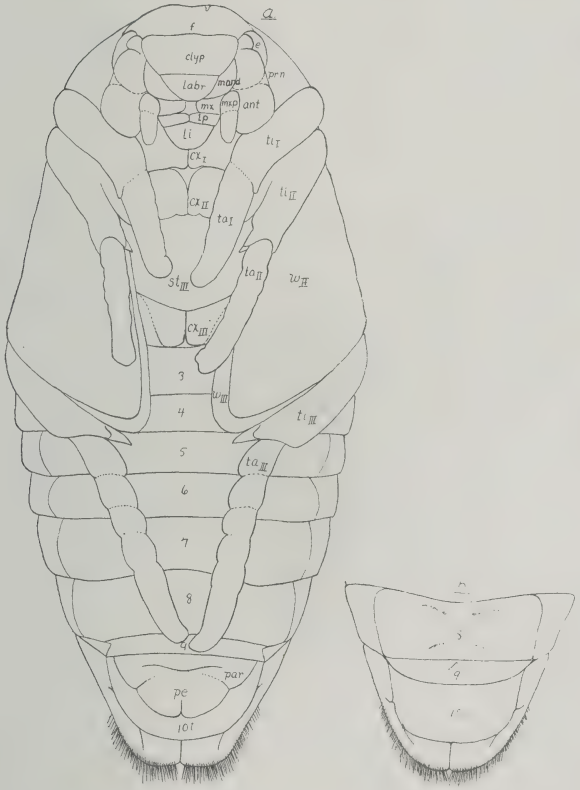

FIG. 51. a. Male pupa, ventral aspect. b. Tip of abdomen of female pupa, ventral aspect. *ant*, antenna; *clyp*, clypeus; *cx*, coxa; *e*, eye; *f*, frons; *labr*, labrum; *li*, labium; *lp*, labial palpus; *mand*, mandible; *mx*, maxilla; *mxp*, maxillary palpus; *par*, paramere; *pen.* penis; *prn*, pronotum; *st*, sternum; *ta*, tarsus; *ti*, tibia; *w*, wing. "*i*" signifies dorsal. The Roman numerals indicate the thoracic segments and the Arabic the abdominal.

dorsally visible nine abdominal segments. Close to the middle of each of the division lines separating the first seven segments from each other is a pair of incised pockets whose edges are slightly curved and heavily chitinized. The eighth segment is convex at the posterior margin, being wider at the middle, and

represents the pygidium of the adult. The ninth segment extends to the tip of the abdomen. The anus is concealed by the anlage of the penis in the male and the tenth segment is probably represented by the membranous integument surrounding it. In the female the broad area on the ventral side posterior to the ninth sternite is the tenth, and the tenth tergite is on the ventral side of the tip of the abdomen.

There are eight pairs of spiracles on the dorsal side, one pair on each of segments one to eight. The eighth pair are reduced and much smaller than those preceding.

LIFE HISTORY AND HABITS

Particular attention has been given to this insect as it lives in lawns and other turf areas in New Haven. A few nurseries have been inspected for larvae, and the same is true of greenhouses, but the economic effect of the beetle seems to be confined entirely to lawns, and the insect has been studied primarily in its relations to these areas. The determination of the life history of soil insects in the field involves much laborious work under the best conditions, and in New Haven the difficulties were increased by this lawn-dwelling habit, most people not being particularly desirous of having their lawns dug up whether or not grubs were present. Most of the data on the immature stages were secured by examining blocks of soil twelve by eighteen inches in surface area and twelve to fifteen inches deep. The number of individuals of each stage was determined every three inches in depth; that is, from the surface to three inches deep, three to six inches, etc. This gave the position of the grubs in each of their stages in the soil and the total number per unit area of surface. In the insectary, the larvae were reared in various kinds of receptables under conditions as near to normal as possible. Moisture conditions were roughly estimated to approximate those of the normal soil. Even under the best of laboratory conditions the environment of growing larvae was probably not identical with the normal environment. The lengths of stages here given are those of insectary-reared individuals except where otherwise stated. These periods checked well with field observations except that the lengths of the larval instars in the insectary were somewhat longer than in the field. The data on the adults were secured both from captive beetles and from field observations. A brief summary of the life cycle in Hawaii has been published by Muir (1912) and in Connecticut by Friend (1927).

The adults emerge from the pupal stage in the ground during the latter part of June, and throughout the months of July and August. They usually remain in the soil one or more days before coming to the surface, and a few specimens have been observed

to remain in the soil seven days, but these cases may represent a much longer time than the average in the field. Pupation occurs at three to nine inches below the surface of the ground, and the adults remain in the pupal chambers until the chitin hardens, which takes about one day. In 1926 the first adults were found in the field June 25, in 1927, June 29, and in 1928, June 26. The last were found August 28, 1926, and September 9, 1927. No field scouting for adults was carried on the latter part of the summer in 1928. In the insectary where conditions of temperature were essentially the same as out-doors, we secured adults as early as June 15 in 1927. During 1926 they were most abundant from July 13 to July 24, and during 1927 from July 11 to July 13. They live from two to three weeks.

Our observations indicate both diurnal and nocturnal activity. During the day the beetles are in flight during both morning and afternoon and are frequently found in flowers, where they feed on the petals, although not extensively. At night they are sometimes found around lights crawling on the ground, window frames, etc. They are not very active when compared with our native May beetles or with the Japanese beetle. Flight is short, often only a few feet, and much of the time is spent in the ground where they are often found in burrows an inch or half an inch deep (Plate XX). No precise data are available on the effect of humidity and temperature on the activities of the adults. In 1927, a record was kept of the sex of 693 adults collected between July 13 and September 9, when the last adult was found. These beetles, with very few exceptions, were picked up on flowers and foliage or on the surface of lawns; 590 were females and 103 were males. The significance of this is not quite clear, for between July 19 and September 3 there emerged from our insectary tiles 176 males and 137 females, near enough to an equality of sexes to cause no comment. The scouts were instructed to examine flowers carefully, and if the females feed more than the males, the preponderance of the former is explained. Muir noticed the same preponderance of females collected on flowers in Hawaii.

The adults feed very little, and it is possible that what they eat may be consumed for the sake of its moisture content. They are frequently found in rose blossoms, hollyhocks, phlox, dahlias, etc., and we have fed them on roses in the insectary, but the amount of food consumed is rarely enough to injure the flower seriously. We fed adults in captivity on pieces of ripe apple. They will not eat an apple the skin of which is entire, but if the flesh is exposed they eat out a cavity about large enough to hold the body. They will also burrow into a wet sponge and bury their heads in wet cotton. Water seems to be the substance sought in this case. If apple pulp is placed in a receptacle where

it cannot be reached except by flight they are not attracted to it and we have never found them on fruit in the field. In the adult stage the feeding habits of this insect are of no economic importance.

A few specimens have been found mating in the field, but most of the observations on the mating habits have been made on adults in captivity. They are both polygamous and polyandrous, mating indiscriminately. One male will mate with more than one female, and one female will mate with more than one male on the same day. No attempt has been made to determine the limit in this direction, but in breeding work in the out-door insectary pairs could be mated at almost any time. In some instances one male has mated with two females successively with no appreciable interval. The reverse has also occurred, and one pair may mate twice the same day. The duration of the act of copulation varies from fifteen minutes to two hours. Mating below the surface of the ground has never been observed in the field or laboratory, and we do not believe it occurs normally.

The intervals between emergence from pupal skin and mating, and between mating and oviposition show much variation. The female may mate and oviposit within one day of the time of shedding the pupal skin, but usually a longer time elapses in captivity, at least. Although as much as five days may elapse between mating and oviposition in captivity, under natural conditions the duration of time may be much less. Whether one mating or more is required for oviposition of the normal number of eggs has not been ascertained. Some females seem to be stimulated to renewed egg-laying activity by a second mating, but oviposition in the laboratory is so irregular that no conclusion has been drawn as regards this matter.

The period of oviposition is from four to twenty days, usually about one week. During this time eggs are laid during both day and night in small groups placed loosely in the ground usually at a depth of between three and nine inches. Six 1928 diggings taken from field records show that of 437 eggs found, 78 per cent. were between three and nine inches below the surface of the soil, 12 per cent. were in the upper three inches of soil, and 10 per cent. were between nine and twelve inches below the surface. Of those found outside the three to nine inch layer, most were close to the three-inch or nine-inch level. Our experience has been that more eggs are found between four and eight inches below the surface in the field than at all other levels. From one to twelve eggs per day are laid in captivity, the largest total number from one beetle being 39, laid over a period of seven days. The average is much less. (We have secured an average of 26.4 eggs per female from nine individuals). The first eggs were found in the field in 1926 on July 19, and the last on Septem-

ber 10. In 1927, the first egg was found on July 3, and the last in September (day not recorded). In 1928, the first eggs were found July 3. The adults will oviposit in ground covered with sod or bare. No search has been made for eggs in bare ground more than a few feet from sod, but they are frequently found in gardens in yards. In tests made to determine the preference of adults for turf or bare ground three trials were made. A box having inside dimensions 10″ x 20″ contained earth covered with sod in one half, and earth without sod in the other, the depth of each half being five inches. In the first trial 25 pairs of adults were placed in each half, a thin partition preventing the two lots from intermingling, and left for four days. The side with sod contained 17 eggs, and the side without sod, 42 eggs. The sod, which was cut from a lawn seeded to red top grass in April and maintained in excellent condition by watering until used in July and August, was not compressed when placed in the frame. This was repeated with five pairs of adults on each side over a period of five days. Six eggs were found on the side containing sod and three on the other. In the third trial nine pairs of adults were placed on each side and the partition was removed above ground, permitting free access to both sides by all 18 pairs for three days. The partition was kept intact below the surface to prevent passage from one side to the other under ground. After three days the side with sod contained 26 eggs, and the side without sod, 22. Of the 116 eggs laid in all trials, 49 were laid in the side containing sod and 67 in the side without sod. The preference, if any, was slight. In breeding these insects in captivity, the adults are confined in small (four-inch to six-inch) flower pots or in jelly jars which contain earth without any living organic matter, and they oviposit very readily, although perhaps not to the extent attained in a more nearly normal environment. The infested area in New Haven is a suburban residential district where the properties have fair-sized lawns, and hence it is impossible to tell from field observations to what extent cultivated land would be infested in this region.

The egg is small and oval when laid, but it soon swells to a more nearly spherical shape and increases much in size. Full size is attained after about two weeks at 24° C. (75° F.) in moist soil. The duration of the egg stage at the same temperature and under the same conditions is 17.3 ± 0.1 days (53 eggs). Under out-door conditions of air temperature and in moist soil the duration of the egg stage for 121 eggs laid between July 14 and August 19 in 1927 was 24.7 ± 0.2 days. In 1926, the average was 27.8 ± 0.6 days for 63 eggs held under similar conditions out-doors and laid between August 2 and September 2. The soil temperature in Westville, New Haven, at a depth of six inches fluctuated during August 1926 and 1927 between the extremes of 61° and

84° F. However, the eggs on which data are given were kept in bottles full of earth in the insectary at air temperature, and the mean is much below 75° F. during July, August, and September, being 71.7° F., 71.3° F., and 62.8° F., respectively, in 1926, and 72.4° F., 66.9° F., and 65° F., respectively, in 1927 (U. S. Weather Bureau figures). Moisture seems absolutely essential to the development of the embryo. Lack of moisture retards development, and an exposure to air-dry conditions for the first ten days is fatal. Submergence in water also retards development, but eggs can survive at least seven days' submergence immediately after being laid.

Just before hatching, the brown tips of the mandibles are visible through the egg shell. Some of the brown setae are also visible through the shell, but the body of the larva is white on hatching. The egg-bursters on the metathorax (Fig. 50) aid the hatching process by pressing against the shell from the inside. These do not act as knives, for the shell breaks in what might be called a frontal plane, but simply furnish points for the application of pressure. The function of these and their morphology are very well described by Rittershaus (1925 and 1927). They are cast off at the first molt. The first newly-hatched larvae were found in the field on August 12, 1926, July 29, 1927, and July 17, 1928. First instar larvae occur during the remainder of the summer and fall and a certain per cent. hibernate.

As soon as they break from the egg shell, the young larvae move up to a point near the surface of the soil to feed on the grass roots and dead organic matter found there. This movement may be affected somewhat by the amount of organic matter in the soil, for if organic matter is plentiful, the larvae tend to migrate less. In normal sandy loam occurring just under the sod as found in New Haven, this tendency to move up is quite manifest. If eggs are placed at the bottom of tubes filled with soil, the larvae move up after hatching, but if the eggs are placed at the top of the tube (one centimeter below the surface of the soil) the larvae stay there. Moisture may possibly be an important factor in the movement of the larvae, for a very dry soil is fatal to them, and excess dryness of the top layers might cause them to go down or remain down more deeply.

Although under normal conditions the young larvae apparently feed on both grass roots and dead organic matter, they can maintain themselves and develop on the latter alone. It is not inferred that the dead organic matter is a sterile medium, for bacteria and fungi are present and may be a very important factor in the nutrition of the larvae.

They will live and grow on soil containing much decayed sod, but in this case the rate of development is not so rapid as when the food supply consists of normal growing turf nor do the larvae

grow to normal size. Aside from direct laboratory experimentation to determine this point, good evidence is given by the migration experiments that development is much more rapid in sod than in sandy loam. Of the 200 first instar larvae placed in the frame containing sod, 141 survived, 84 being in the second instar and 57 being in the first after 21-23 days. Of the 200 placed in the frame without sod, 95 survived, 35 being in the second instar and 60 in the first. These 400 larvae were all from miscellaneous insectary-reared material and were not selected for age. The average larval age was the same, as the lot was mixed. In the migration experiment with the small frame, 28 larvae survived in the frame without sod, and only eight of these had reached the second instar after 28-29 days. In the frame with sod, 36 larvae survived and 27 had reached the second instar. It is interesting to note that first instar larvae in the summer feeding season can survive a fairly long period of time and develop somewhat in soil no richer in organic matter than garden sandy loam.

The young larvae migrate laterally to some extent, depending much on the nature of the soil. If sod is present, migration is less than when the soil contains no sod. Figure 52 shows the distribution of larvae when living sod is present or absent. The frames used were two feet square inside, six inches deep, and with 20-mesh copper screen on the bottom. Each frame was filled to within one inch of the top and set in the ground out-doors. One frame contained sandy loam with no sod, and the other contained in the center a circular piece of sod one foot in diameter. The larvae (first instar) were placed with a little earth in a jelly jar having a two and a half-inch mouth, and this was inverted over the exact center of the frame and the larvae allowed to dig in. After 21 to 23 days (August 16 to September 6 to 8) the soil was removed in concentric rings one inch in thickness beginning at the periphery. All larvae found beyond twelve inches from the center were in the corners, and all larvae found in the first four inches from the center are given in one total. Two hundred larvae were placed in each frame. The method of handling accounts for much of the mortality, and the figures represent the survivors. In the frame with no sod, 95 larvae survived, and in the frame with sod, 141 larvae survived. In this latter frame 111 (79 per cent) of the larvae were within six inches of the center, (that is, in the sod itself) and only ten (seven per cent) were more than ten inches from the center, whereas in the frame containing no sod, 11 (11.6 per cent) were within six inches of the center, and 40 (41.9 per cent) were more than ten inches from the center. The presence of living sod very apparently influences migration in the soil, and this is substantiated by similar tests made with third instar larvae as given on page 637 and in Figure 53.

In two similar frames one foot square inside and filled three

inches deep, one frame containing no sod and one being entirely turf, the distribution of the larvae show a similar tendency. One hundred larvae were placed in each frame on August 17, 1927, and an examination was made as before on September 14 and 15. Of the 28 survivors in the frame with no sod, 20 (71 per cent) were over five inches from the center, and in the frame with sod 20 (55 per cent) of the 36 survivors were over five inches from the center. The low survival rate in these last frames was probably due to the method of handling and to drying out. If concentrated in a small space, the larvae bite each other with frequently fatal results from infection.

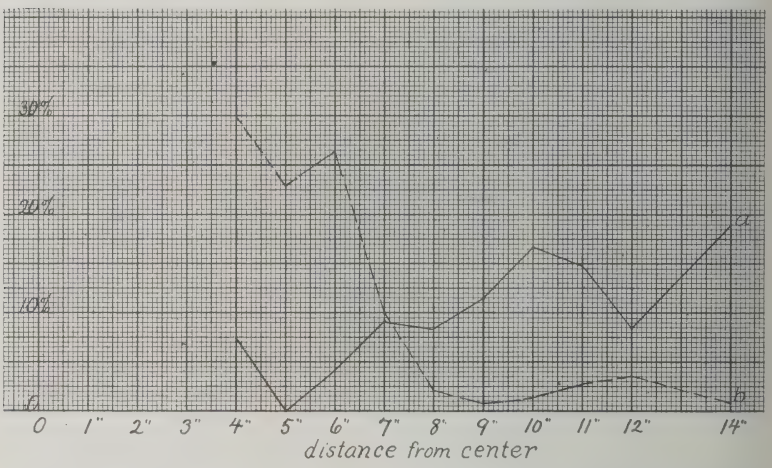

FIG. 52. Migration of first instar larvae in frame. a. 95 larvae in frame with no living grass. b. 141 larvae in frame containing living turf.

The length of each instar has not been satisfactorily determined owing to the difficulty of obtaining normal growing conditions in the laboratory where the larvae can be observed. Twenty-three larvae in 1927 (August 8 to November 2) under normal outdoor temperature conditions averaged 35.1 ± .7 days for the duration of the first instar. When held at a temperature of 23°—25°C., the first instar is completed in less than 30 days. In both cases larvae were kept in living sod. Under the same conditions larvae fed on soil rich in dead organic matter (decayed sod) take about one-third again as long (about 40 days). The second instar apparently takes about as long as the first, and the majority of larvae hibernate in the third instar. The first week in September the second instar larvae become common and injury to lawns becomes noticeable at this time. By the last of September most of the larvae are in the third instar. The second and third instars feed

as does the first, and it is the activity of these later stages which injures the grass so severely (Plate XX). In 1928, the first injury to grass was noted August 17, the larvae being then in the second instar, and by September 15 the injury to lawns was very severe. The roots are cut off close to the crown, and in heavy infestations the dead grass can be rolled off the surface of the soil with ease.

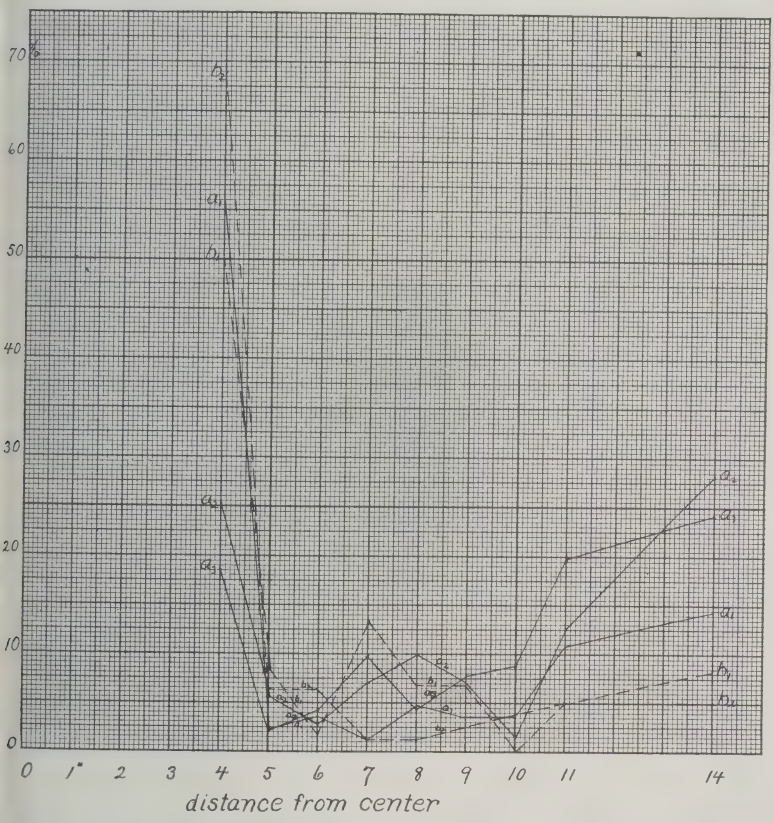

FIG. 53. Migration of third instar larvae in frame. a_1, 84 larvae; a_2, 71 larvae; a_3, 91 larvae—all in frame with no living grass. b_1, 60 larvae; b_2, 80 larvae—all in frame containing living turf.

The larvae are found in the characteristic position just below the surface of the soil. The third instar shows more lateral migration in the absence of grass roots than when in sod, as curves in Figure 53 indicate. One hundred larvae were used in each trial and the figures represent the survivors. The larvae remained in the frames as follows: a_1, Sept. 21-24; a_2, Sept. 23-28; a_3, Sept. 28-30; b_1,

Sept. 21-28; b_2, Sept. 29-30. The procedure was the same as with larvae of the first instar (page 635). The difference is not so great as with the larvae of the first instar, but the time was much shorter in every case. Lot a_1 had a higher per cent within the first four inches of the center than b_1, but the larvae were in the frame in the former case three days as against seven days in the latter, and even with this greater length of time the dispersion beyond four inches shows a greater migration when no grass roots are present. The tendency to move farther laterally in the absence of grass may be a factor of some importance in controlling the larvae when arsenate is used in the soil. Although a search for food may be the primary cause of this migration, variations in the temperature and in the moisture content of the soil may have some effect. Grass cover on soil alters both temperature and moisture content when compared with a denuded area.

About the middle of October the larvae begin to move more deeply into the soil to hibernate, and by the time the ground freezes they are well below the surface. Hibernation occurs at a depth of from ten to fifteen inches usually, although the character of the soil seems to be a factor which influences this to a certain extent. In lighter and more easily penetrated soils the tendency is to go more deeply. Most of the larvae are in the third instar when hibernation occurs, but some are in the second and first instars. Figure 54 shows graphically the percentage of different stages found in the field as given in Table 6. In Figure 55 is shown the rate of

TABLE 6—SEASONAL OCCURRENCE OF EGGS, LARVAE AND PUPAE

April 21-30	Eggs	1st instar	2nd instar	3rd instar	Prepupae	Pupae	Total
4-25-28	0	1	36	242	0	0	279
4-26-26	0	5	0	49	0	0	54
4-26-28	0	0	0	34	0	0	34
4-29-27	0	0	7	20	0	0	27
	0	6 2%	43 11%	345 87%	0	0	394
May 1-10							
5-2-27	0	0	8	7	0	0	15
5-4-27	0	0	4	55	0	0	59
	0	0	12 16%	62 84%	0	0	74
May 11-20							
5-11-28	0	0	14	93	0	0	107
5-12-27	0	0	4	0	0	0	4
5-17-28	0	0	0	33	0	0	33
	0	0	18 13%	126 87%	0	0	144
May 21-30							
5-24-28	0	0	3 6%	45 94%	0	0	48
May 31-June 9							
6-4-28	0	2 3%	13 22%	40 70%	3 5%	0	58
June 10-19							
6-7-28	0	0	1	11	11	0	23
6-13-28	0	0	19	13	13	4	49
6-15-28	0	0	2	9	37	6	54
6-16-28	0	0	3	11	12	4	30
6-17-26	0	0	0	3	31	52	86
6-18-26	0	0	0	8	2	7	17
6-18-28	0	0	5	5	5	25	40
	0	0	30 10%	60 20%	111 37%	98 33%	299

TABLE 6—SEASONAL OCCURRENCE OF EGGS, LARVAE AND PUPAE —*Continued*

	Eggs		1st instar		2nd instar		3d instar		Prepupae		Pupae		Total
June 20-29													
6-25-26	0		0		0		20		12		8		40
6-25-28	0		0		10		9		0		8		27
6-26-28	0		0		2		3		3		35		43
6-27-28	0		0		6		11		2		27		46
6-29-26	0		0		0		5		9		19		33
	0		0		18	10%	48	25%	26	14%	97	51%	189
June 30-July 9													
6-30-26	0		0		0		11		4		15		30
7-2-28	0		0		0		1		1		0		2
7-3-28	2		0		1		3		0		12		18
7-5-28	60		0		0		4		0		3		67
	62	53%	0		1	1%	19	16%	5	4%	30	26%	117
July 10-19													
7-12-28	45		0		0		2		0		0		47
7-17-28	263		40		0		3		0		0		306
7-19-26	12		0		4		1		1		0		18
	320	86%	40	11%	4	1%	6	2%	1		0		371
July 20-29													
7-20-28	11		4		10		0		1		0		26
7-26-28	19		211		0		3		0		0		233
	30	12%	215	83%	10	4%	3	1%	1		0		259
July 30-Aug. 8													
7-30-26	50		1		0		3		2		0		56
7-30-28	0		92		0		6		0		0		98
7-31-26	15		0		0		0		0		2		17
8-2-28	0		165		0		2		0		0		167
8-4-26	10		0		0		1		0		1		12
8-6-28	2		0		0		0		0		0		2
	77	22%	258	73%	0		12	3%	2	1%	3	1%	352
Aug. 9-18													
8-15-28	5		120		118		9		0		0		252
8-16-28	0		32		3		5		0		1		41
8-17-28	0		42		86		13		1		0		142
	5	1%	194	45%	207	48%	27	6%	1		1		435
Aug. 19-29													
8-20-28	0		22	11%	168	83%	13	6%	0		0		203
Aug. 29-Sept. 7													
8-30-28	0		2	3%	53	83%	8	12%	1	2%	0		64
Sept. 8-17													
9-8-28	0		6		76		1		0		0		83
9-9-27	0		0		163		51		0		0		214
9-10-27	0		25		2		0		0		0		27
9-11-28	0		16		141		37		2		0		196
9-12-27	0		14		137		38		0		0		189
9-14-27	1		0		1		0		0		0		2
9-15-27	1		2		0		0		0		0		3
9-16-27	0		1		16		3		0		0		20
9-17-27	1		15		19		6		0		0		41
9-17-28	0		0		30		135		0		0		165
	3		79	8%	585	62%	271	29%	2		0		940
Sept. 18-27													
9-19-27	0		17		88		67		0		0		172
9-20-27	0		9		46		93		0		0		148
9-21-27	0		0		0		73		0		0		73
9-22-27	0		25		53		281		0		0		359
9-23-27	0		13		100		87		0		0		200
9-24-27	0		2		96		95		0		0		193
9-26-27	0		43		118		247		0		0		408
9-27-26	0		1		4		1		0		0		6
	0		110	7%	505	32%	944	61%	0		0		1559

TABLE 6—SEASONAL OCCURRENCE OF EGGS, LARVAE AND PUPAE —*Concluded*

	Eggs	1st instar		2nd instar		3rd instar		Prepupae		Pupae	Total
Sept. 28–Oct. 7											
9-28-28.....	0	1		9		70		0		0	80
9-29-26.....	0	0		0		72		0		0	72
10-1-26.....	0	0		15		4		0		0	19
10-2-28.....	0	4		40		139		3		0	86
10-4-26.....	0	1		7		27		0		0	35
10-5-26.....	0	0		3		6		0		0	9
	0	6	1%	74	18%	318	80%	3	1%	0	401
Oct. 8-17											
10-8-26.....	0	2		14		16		0		0	32
10-8-28.....	0	0		3		46		0		0	49
10-9-28.....	0	1		16		132		0		0	149
	0	3	1%	33	14%	194	84%	0		0	230
Oct. 18-27											
10-18-28.....	0	2		1		94		0		0	97
10-20-27.....	0	11		22		219		0		0	252
10-21-27.....	0	0		15		199		0		0	214
10-22-27.....	0	0		0		38		0		0	38
10-24-27.....	0	17		37		45		0		0	99
10-25-27.....	0	11		43		176		0		0	230
10-26-27.....	0	10		36		204		0		0	250
10-27-27.....	0	5		15		87		0		0	107
	0	56	4%	169	13%	1062	83%	0		0	1287
Oct. 28-Nov. 6											
10-28-27.....	0	2		21		87		0		0	110
10-29-27.....	0	0		13		74		0		0	87
10-31-27.....	0	0		7		39		0		0	46
11-1-27.....	0	0		4		44		0		0	48
	0	2	1%	45	15%	244	84%	0		0	291
Nov. 7-16											
11-7-27.....	0	2		4		66		0		0	72
11-10-27.....	0	0		4		67		0		0	71
11-15-27.....	0	4		110		206		0		0	320
	0	6	1%	118	24%	339	73%	0		0	463
Nov. 17-26											
Nov. 27-Dec. 6											
11-30-27.....	0	5	2%	98	33%	194	65%	0		0	297
Dec. 7-16											
12-14-27.....	0	0		18	24%	58	76%	0		0	76

descent into the soil according to Table 7. During the month of October, 1927, the soil temperature in Westville, New Haven, at a depth of three inches fluctuated betwen 78° F. and 39° F, and in November between 58° and 31°, and the descent in the soil occurs in these two months. This movement down into the soil is not necessary for survival of the low temperatures, although it always occurs as winter approaches. In October of 1926, 24 larvae were buried at each of the depths given in Table 8 and allowed to remain until April 1, 1927. The larvae were placed in salve tins 2⅜ inches in diameter and 1⅝ inches deep, two larvae in each tin, and the tins filled with earth. In the cover and bottom of each tin a one-inch hole was cut and copper screen soldered over the openings. The depth was measured from the surface of the soil to the center of the container. Twenty-four larvae were placed at each depth. The differences in survival at

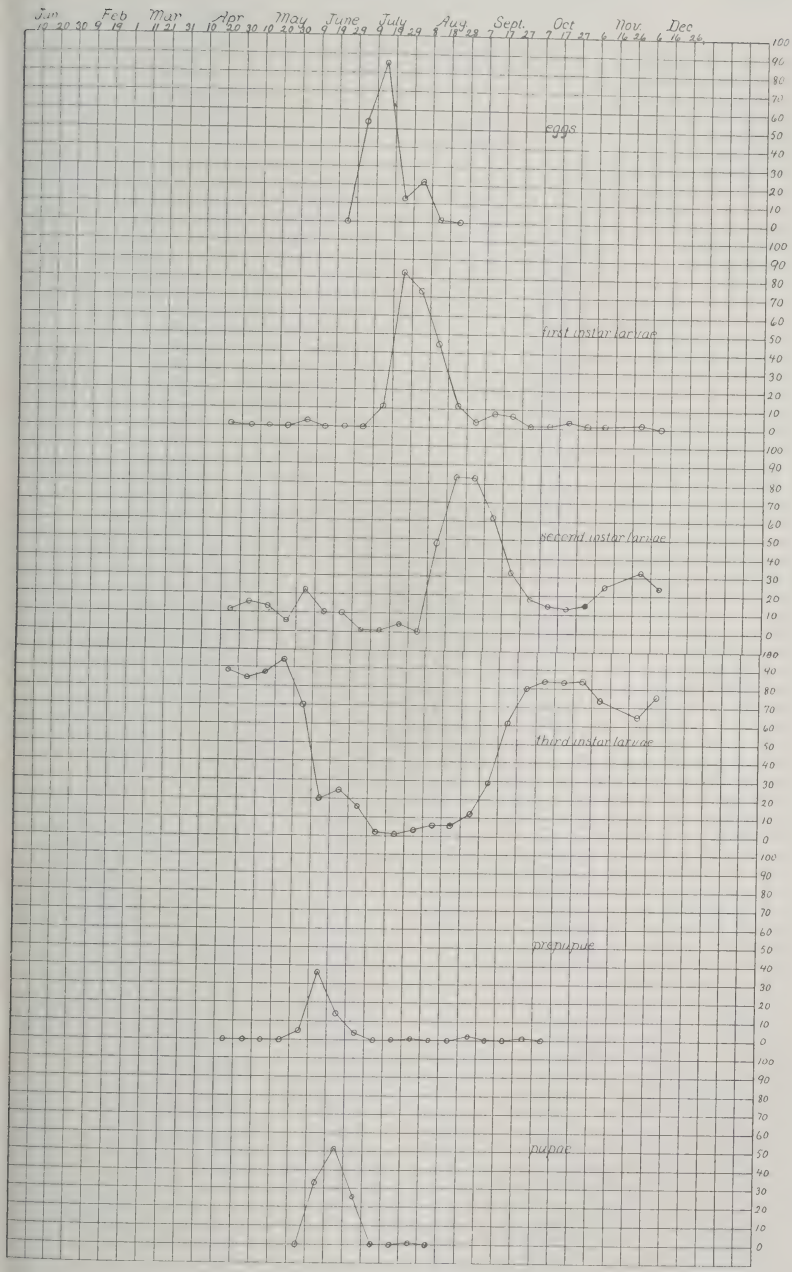

FIG. 54. Percentages of different stages found in the field in 1926, 1927 and 1928.

TABLE 7—DEPTH OF LARVAE IN SOIL
(Including prepupae)

	0–3″		3–6″		6–9″		9–12″		12–15″	Total
April 21-30										
4-25-28	237		31		8		3		0	279
4-26-26	11		17		15		11		0	54
4-26-28	33		1		0		0		0	34
4-29-27	9		13		3		2		0	27
4-30-27	117		17		22		51		0	207
	407	68%	79	13%	48	8%	67	11%	0	601
May 1-10										
5-2-27	50		23		9		4		0	86
5-4-27	62		14		17		7		0	100
	112	60%	37	20%	26	14%	11	6%	0	186
May 11-20										
5-11-28	95		5		4		3		0	107
5-17-28	28		2		2		1		0	33
	123	88%	7	5%	6	4%	4	3%	0	140
May 21-30										
5-24-28	41	85%	5	10%	2	4%	0		0	48
May 31-June 9										
6-4-28	47	58%	23	28%	9	11%	2	2%	0	81
June 10-19										
6-13-28	30		9		7		2		0	48
6-15-28	21		20		0		0		0	41
6-16-28	15		8		3		0		0	26
6-17-26	3		18		1		0		0	22
6-18-26	3		11		3		0		0	17
	72	47%	66	43%	14	10%	2	1%	0	154
June 20-29										
6-25-28	17		2		0		0		0	19
6-26-28	5		1		1		1		0	8
6-27-28	14		4		1		0		0	19
6-29-26	11		6		0		0		0	17
	47	75%	13	21%	2	3%	1	2%	0	63
June 30-July 9										
6-30-26	7		3		1		0		0	11
7-2-28	2		0		0		0		0	2
7-3-28	4		0		0		0		0	4
7-5-28	2		0		0		0		0	2
	15	80%	3	16%	1	5%	0		0	19
July 10-19										
7-12-28	2		0		0		0		0	2
7-17-28	21		8		14		0		0	43
7-19-26	4		0		2		0		0	6
	27	53%	8	16%	16	31%	0		0	51
July 20-29										
7-20-28	10		2		3		0		0	15
7-26-28	82		98		28		6		0	214
	92	40%	100	44%	31	14%	6	3%	0	229
July 30-Aug. 8										
7-30-26	1		4		1		0		0	6
7-31-28	71		18		9		0		0	98
7-31-26	0		2		0		0		0	2
8-2-28	158		9		0		0		0	167
8-4-26	0		2		0		0		0	2
	230	84%	35	13%	10	4%	0		0	275
Aug. 9-18										
8-15-28	236		10		1		0		0	247
8-16-28	40		0		0		0		0	40
8-17-28	111		21		7		3		0	142
	387	90%	31	7%	8	2%	3	1%	0	429

TABLE 7—DEPTH OF LARVAE IN SOIL

(Including prepupae)—*Concluded*

	0–3″		3–6″		6–9″		9–12″		12–15″		Total
Aug. 19-28											
8-20-28	145	71%	42	21%	16	8%	0		0		203
Aug. 29-Sept. 7											
8-30-28	62	96%	1	2%	1	2%	0		0		64
Sept. 8-17											
9-8-28	83		0		0		0		0		83
9-9-27	156		44		14		0		0		214
9-10-27	18		6		3		0		0		27
9-11-28	135		54		5		2		0		196
9-12-27	159		19		1		0		0		179
9-17-27	13		25		2		0		0		40
9-17-28	114		32		16		3		0		165
	678	75%	180	20%	41	4%	5	1%	0		904
Sept. 18-27											
9-19-27	107		50		12		2		0		171
9-20-27	124		8		2		0		0		134
9-21-27	230		64		35		0		0		329
9-22-27	172		7		1		0		0		180
9-23-27	169		12		7		0		0		188
9-24-27	154		18		2		0		0		174
9-26-27	365		33		9		0		0		407
9-27-26	6		0		0		0		0		6
	1327	84%	192	12%	68	4%	2		0		1589
Sept. 28-Oct. 7											
9-28-28	76		4		0		0		0		80
9-29-26	70		1		0		1		0		72
10-1-26	16		2		0		1		0		19
10-2-28	171		8		4		3		0		186
10-4-26	32		1		2		0		0		35
10-5-26	9		0		0		0		0		9
	374	93%	16	4%	6	2%	5	1%	0		401
Oct. 8-17											
10-8-26	26		3		2		1		0		32
10:8-28	35		13		1		0		0		49
10-9-28	137		8		3		1		0		149
	198	86%	24	10%	6	3%	2	1%	0		230
Oct. 18-27											
10-18-28	57		14		13		13		0		97
10-20-27	197		27		19		9		0		252
10-21-27	176		28		6		2		0		212
10-22-27	38		0		0		0		0		38
10-24-27	74		13		5		3		0		95
10-25-27	127		26		25		13		0		191
10-26-27	124		35		43		34		0		236
10-27-27	53		15		22		13		0		103
	846	69%	158	13%	133	11%	87	7%	0		1224
Oct. 28-Nov. 6											
10-28-27	71		12		16		11		0		110
10-29-27	12		26		30		17		2		87
10-31-27	23		16		4		3		0		46
11-1-27	22		15		9		2		0		48
	128	44%	69	24%	59	20%	33	11%	2	1%	291
Nov. 7-16											
11-7-27	12		37		12		4		0		65
11-10-27	4		18		36		13		0		71
11-15-27	26		120		86		47		50		329
	42	9%	175	38%	134	29%	64	14%	50	11%	456
Nov. 17-26											
Nov. 27-Dec. 6											
11-30-27	6	2%	82	27%	104	34%	79	26%	37	12%	307
Dec. 7-16											
12-14-27	0		19	25%	12	16%	21	28%	24	32%	76

TABLE 8—SURVIVAL OF LARVAE OVER WINTER

Depth (in.)	Recovered alive	Per cent living
3	20	83
6	18	75
9	21	88
12	19	79
15	17	71

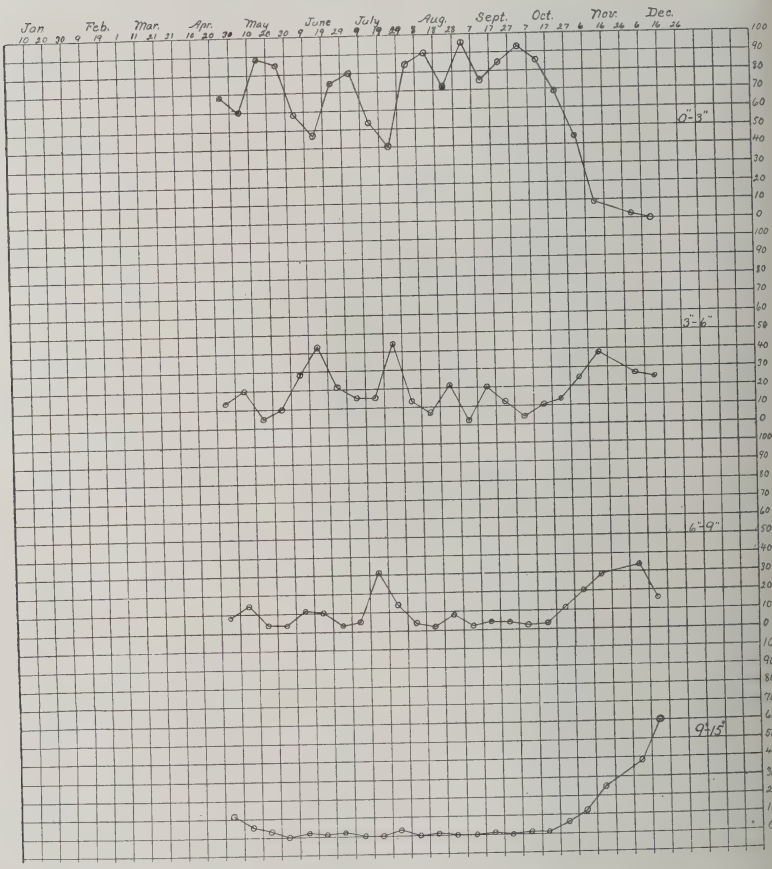

FIG. 55. Percentages of larvae (including prepupae) found at different depths in the soil in 1926, 1927 and 1928.

different depths cannot be considered significant with one experiment on a few animals, but it is quite apparent that the larvae can survive the winter in this locality with no great difficulty. If any larvae should attempt to hibernate within less than three inches of

the surface, the mortality might be greater. A certain mortality is to be expected as a result of handling. The winter mortality under normal field conditions is negligible so far as our digging records indicate.

TABLE 9—SURVIVAL OF LARVAE OVER WINTER

	Instar	Oct. 5	Oct. 31	Nov. 7	Nov. 15	Nov. 30	Dec. 14	Apr. 25	May 17	May 24
0-3″	1st	..	0	1	0	0	0	0	0	0
	2d	..	0	0	1	1	0	10	0	2
	3d	..	23	11	1	0	0	227	28	39
3-6″	1st	..	0	1	0	1	0	0	0	0
	2d	..	6	3	5	5	5	26	0	0
	3d	..	10	33	47	12	14	14	2	5
6-9″	1st	..	0	0	0	0	0	0	0	0
	2d	..	1	0	2	2	2	0	0	1
	3d	..	3	12	7	14	10	1	2	1
9-12″	1st	..	0	0	0	0	0	0	0	0
	2d	..	0	1	2	3	6	0	0	0
	3d	..	3	3	15	13	15	0	1	0
12-15″	1st	..	0	0	0	0	0	0	0	0
	2d	..	0	0	1	0	5	0	0	0
	3d	..	0	0	1	4	19	0	0	0
Total No. of Larvae		63	46	65	82	55	76	278	33	48
Diggings		1	1	1	1	1	1	4	1	1
Per Digging		63	46	65	82	55	76	69.5	33	48

In Table 9 are given the results of the examination of a small infested area during the fall of 1927 and spring of 1928. The diggings were made very close together, a few inches separating them, and hence any lateral migration in the spring would disperse larvae into previously examined areas from which the larvae had been removed. This would thin the remaining infestation, which probably accounts for the drop in May. According to information received from the Japanese Beetle Laboratory of the Federal Bureau of Entomology there is a high mortality of the larvae of *Popillia japonica* in May, assigned by investigators to pathogenic bacteria, fungi, and other natural causes. This may also explain the decrease in the number of larvae of *Anomala orientalis* at this time. April 25 there were as many larvae per unit area as were present the previous November and December. There was no great apparent winter mortality under the conditions described.

With the advent of warm weather in the spring, the larvae come up close to the surface to feed, usually the latter part of April. Here they remain until the first part of June, when they go down a few inches to pupate. In the spring the grass is more vigorous than in the autumn, and the larvae feed less extensively, so the injury to the grass is less evident. A few larvae do no feeding

whatsoever in the spring, and many can go through pupation without living grass roots for food, the dead organic matter in the soil being sufficient. Many of the second and first instar larvae coming from hibernation apparently do not pupate but go through the season as larvae and hibernate in the third instar the following winter. This seems to be the case with the majority of these immature larvae, and many have been carried through two seasons in the insectory. These represent but a small per cent of the total however, and most of the individuals complete development the first spring and summer after hibernation (Fig. 54).

The duration of the second and third instars depends much on environmental conditions. When larvae hatch late in the season the cool weather may delay development. Under similar conditions the first two instars take about the same length of time—one month. Under laboratory conditions and at an incubator temperature of 23° to 25° C. the larvae pass through two instars of growth in less than two months if kept in grass sod, and the entire larval period from hatching to pupation takes about 208.5 days (average of nine larvae which varied from 184 to 254 days).

Development depends on the nature of the food supply and on moisture as well as on temperature. Development takes place in soil containing decaying organic matter alone, and in the laboratory many larvae have been carried through to the prepupal stage on sod compost, although the duration of larval life was longer than that of larvae kept in living sod (at the time of writing these larvae are still in the prepupal stage, 222 days after hatching, the temperature being 23-25° C.* Lack of moisture is very quickly fatal and larvae cannot survive under air-dry conditions. When the soil is moist the first instar will live sometimes two weeks after hatching without any organic matter. In the laboratory newly hatched individuals in a few cases survived 11, 13 and 15 days in moist sand or mixed sand and brickyard clay. Under natural conditions the larvae could avoid excessive dryness by digging more deeply into the soil, but as long as the grass is alive they remain near the surface. In 1928, between May 1 and May 17 at New Haven, the precipitation was only .18 inches, and between May 12 and May 17 there was no rain whatsoever, yet on this latter date larvae were found feeding in the upper three inches of soil. Excessive moisture in the soil has little or no effect except possibly in flooded areas. We have no data on the latter condition, as none of the heavily infested area in New Haven is flooded at any season. Under artificially created conditions when the soil in which larvae were hibernating became so mucky that the cavities in the soil containing larvae were filled and the larvae tightly packed, death resulted in most cases. This condition could hardly

*Two adults have since been secured ,one 274 and one 254 days after hatching.

be maintained in a natural environment, for the larvae were in metal containers where it was impossible for them to dig deeply into the soil, and water stood in the containers several weeks. It appears that as long as the larva can maintain freedom of movement in the soil it can survive.

The optimum conditions for larval development appear to be those that are attained in an open lawn exposed to the sun with a good cover of grass and with a fairly rich sandy loam. Any of the lawn grasses and clovers found in the infested area are eaten by the larvae. It is quite apparent that adverse conditions may be largely overcome. Prolonged rain, droughts, and cold weather have little apparent effect on the survival in this region. If no organic matter is present, it may be reached by lateral migration through the soil, for the newly-hatched larvae can survive days without it. Living roots are not absolutely necessary to development. The adults do not fly far in this climate and usually oviposit in an area favorable to development.

About the first of June the larvae dig into the ground to a depth of three to nine inches and undergo a prepupal quiescent stage. The intestine is emptied of its contents and the larva is yellowish-white in color. The abdomen is bent ventrally on itself in a very characteristic position (see Plate XIX), and the legs are folded up at the coxa-trochanter joint. Power of locomotion is lost, and the only movement is flexing and reflexing of the abdomen. By this movement a hollow space is formed in the soil, and in this space pupation occurs. The prepupal period varies somewhat and has been calculated as the period between loss of the power of locomotion and ecdysis. In 1926 this period was $6.9 \pm .12$ days in length (63 prepupae) and in 1927 the same period was $5.5 \pm .24$ days in length (20 prepupae). These observations in 1926 were made between June 19 and July 21, and in 1927 between July 9 and July 25. In the laboratory at 24° C. seven individuals had a prepupal stage varying from thirteen to six days and averaging 8.3 days. The depth to which the larvae will dig depends much on the nature of the soil. In the field most of the prepupae are found between three and nine inches below the surface, but they occur at a depth of 12 inches, and in tiles used for rearing, where the soil was relatively loose and easily penetrated, they went down 15 inches. When ready to pupate the larva splits the integument along the entire epicranial suture, the mid-dorsal line of the thorax, and the mid-dorsal line of abdominal segments 1-3.

Pupation occurs the last of June and the first of July in the majority of cases. In 1926 the first pupae were found in the field June 17, in 1927, June 15, and in 1928, June 13, and the last pupae were found in 1927 on August 19 and in 1928 on August 16. The pupal stage lasts about two weeks,

40 individuals having an average of 14.8 ± .75 days in 1926 (observations made between June 28 and July 25) and in 1927 14 individuals averaged 13.7 ± .12 days (observations made between July 14 and August 8). These are insectary records. In the laboratory at 24° C. seven individuals varied from 11 to 13 days and averaged 11.7 days. During the last two weeks in June the temperature of the soil in Westville, New Haven, fluctuated between 56° F. and 82° F. at six inches depth in 1926 and 1927. The pupa remains within the cast larval skin. Plate XIX shows the characteristic position.

As given here, the total life cycle occupies one year, and for most individuals this is true. Figure 54 gives the percentages of different stages (except the imago) found during the year in New Haven. This figure is drawn from Table 6, which gives the results of a large number of diggings made during 1926, 1927, and 1928. Figure 55 shows the depth at which the larvae are found during the year according to Table 7. If the average adult life prior to oviposition be considered four days (this represents the average time from emergence from the pupal stage to the middle of the period of oviposition), then the following table shows the duration of different stages for 1926 and 1927. These figures are for individuals reared in the insectary under conditions as close as possible to normal.

TABLE 10—LENGTH OF DIFFERENT STAGES AT NEW HAVEN.

	1926		1927	
Adult (to oviposition)..	4	days	4	days
Egg.....	27.8	"	24.7	"
Larva (by difference)..	311.5	"	317.1	"
Prepupa.....	6.9	"	5.5	"
Pupa.....	14.8	"	13.7	"

A small percentage of larvae hibernate in the first and second instars, and some of these apparently have a two-year life cycle. In the insectary we carried these through two years, and our observations indicate that this is the case in the field. This extension of the life cycle may be due to a relatively poor food supply, to low temperatures at a critical stage of development, to internal factors, or to a combination of these. A small percentage of larvae do very little, if any, spring feeding, and these are probably the two-year individuals. An examination of Figure 54 shows the peak of prepupal abundance between June 9 and June 19, of pupal between June 19 and 29, of eggs between July 9 and 19, of first instar larvae between July 19 and August 8, of larvae of the second instar between August 18 and September 7. It also shows that one to two per cent of the hibernating larvae are in the first instar

and about twenty per cent in the second instar. Figure 55 gives the depth at which larvae are found during the year. The drop in per cent found in the upper three inches of soil in June is due to the prepupal stage and in July to the hatching of larvae from eggs and their being discovered before they came to the upper layer of soil. A comparison with Figure 54 makes this clear, as well as other facts in the life cycle. Figure 55 also shows the ascent and descent in the soil in the spring and fall. In making these charts the data for all three years have been combined, but the variations due to seasonal differences in these years have been largely eliminated by using the totals of ten-day periods in computing the percentages. All the necessary information may be found in the tables.

CONTROL

Natural Factors

There is at present in New Haven to the best of our knowledge, no one natural factor or group of such factors which will keep the numbers of this insect down to a harmless level. The effect of climate on the increase and spread of this insect is a matter on which little information is available. The low winter temperatures have no great effect. Hibernation occurs in the larval stages and the larvae go down into the soil to a depth of 10 to 15 inches. As has been previously noted (page 640) they can survive the winter even if as near the surface as three inches. The effect of natural environmental factors has been further discussed on pages 640 to 647 of this bulletin.

Starlings are very frequently seen feeding on larvae in heavily infested areas, but even where this feeding has been extensive, there are enough live larvae left in the soil to injure the grass.

The Federal Bureau of Entomology is at present introducing parasites of the Japanese and Asiatic beetles, and a lot of 290 *Tiphia popilliavora,* a wasp native to Japan, was released in Westville, September 6, 1928, by Mr. J. L. King of the Bureau. This wasp is known to parasitize the larvae of *A. orientalis,* but it is too early to state whether or not the parasite will establish itself here. In the Hawaiian Islands the beetle has been eliminated as an economic pest by the introduction of another wasp, *Scolia manilae,* but attempts to establish this in the United States have failed. It apparently cannot withstand the climate, for its native home is the Philippine Islands, and it is not active at normal summer temperatures in Connecticut according to information received from Mr. Loren B. Smith, of the Japanese Beetle Laboratory at Moorestown, New Jersey.

A small percentage of larvae are destroyed in Hawaii by bacterial and fungous (Metarrhizium) diseases, but not enough to be

of any economic importance. We have never observed any marked mortality due to these causes in Connecticut.

Insecticides

The entomologists of the Hawaiian Sugar Planters' Experiment Station tried to protect sugar-cane from the attacks of the larvae of this insect by means of various insecticides. The injection of cyanide of potassium solution, seven ounces in one quart of water, by the Mamelle process was not successful (Muir, 1912 and Swezey, 1913); 20 cc. per stool of cane gave only 4.25 per cent kill of grubs. Gasoline injected at the rate of 20 cc. on four sides of a hill killed only 20 per cent of the larvae. Carbon disulfide injected at the rate of 10 cc. every ten inches in the row gave 95 per cent kill but was considered too expensive and possibly dangerous to the plants. After the success which accompanied the establishment of *Scolia manilae,* further control experiments were abandoned.

In Connecticut Zappe and Garman (1924) tried calcium cyanide, sodium cyanide, kerosene emulsion, bichloride of mercury, and carbon disulfide emulsion against the larvae. The cyanides killed the grubs but proved toxic to grass at a strength necessary to insure a heavy mortality of larvae, and kerosene emulsion and bichloride of mercury were considered of no value. Carbon disulfide emulsion proved successful. In 1926, Britton and Zappe reported further unsuccessful trials with calcium cyanide. There is no question of the ability of this poison to kill the larvae, but it cannot be safely applied to lawns. In 1926, Johnson, using methods of treatment with carbon disulfide emulsion developed at the Japanese beetle laboratory at Riverton, N. J., treated 43.5 acres of lawns in New Haven with an emulsion containing 70 per cent of CS_2 diluted 200 times with water. He secured a high mortality of larvae, up to 98 per cent in some cases, and did not injure the turf (Johnson 1927). It was found, however, that the use of carbon disulfide emulsion effected but a temporary relief, and that the following season the lawns became reinfested.* This treatment would have to be applied every year to be effective, and some skill is required to avoid injuring the grass. Leach and his collaborators at Riverton developed a means of treating turf with lead arsenate and thereby insuring it against damage by Japanese bettle larvae for some period of time. This method is well described by Leach and Lipp (1927) and by Leach (1928). Arsenate of lead is added to the top layer of soil and the larvae in this layer, eating

*The lawns were treated in the spring and fall of 1926 and in the spring of 1927, and at the present time, fall of 1928, the population of larvae in the treated area, as indicated by the appearance of the lawns, is approximately the same as before treatment, although the infestation is more widely spread.

the arsenate, are thereby poisoned. A few lawns in New Haven were so treated, the acid lead arsenate being applied at the rate of three pounds to 100 square feet of surface and then worked into the upper two inches of soil with a hand rake. The ground was then seeded with one of the bent grasses, and a good turf resulted. The soil so treated has maintained a good turf for two years without further poisoning, and in New Jersey some of the plots treated by Leach in this manner have remained free of injury eight years.

According to the latest recommendations for grub-proofing golf greens with lead arsenate, the use of so much poison is not necessary against the Japanese beetle, and since the Asiatic beetle is closely related and of similar habits, less poison may possibly be effective against it in lawns. For newly constructed greens Leach

Table 11—Effect of Lead Arsenate on Larvae

Lead Arsenate	First Instar			Second Instar		
	No. of Larvae	Absolute Survival 10-11 days	Relative* Survival 10-11 days	No. of Larvae	Absolute Survival 12-16 days	Relative Survival 12-16 days
1 g. per liter	60	14 = 23%	48%	40	20 = 50%	77%
1.5 g. " "	60	8 = 13%	27%	40	14 = 35%	54%
1.75 g. " "	60	15 = 25%	52%	40	12 = 30%	46%
2.00 g. " "	60	8 = 13%	27%	40	8 = 20%	31%
2.25 g. " "	60	7 = 12%	24%	40	14 = 35%	54%
2.50 g. " "	60	1 = 2%	3%	40	6 = 15%	23%
3.00 g. " "	60	3 = 5%	10%	40	7 = 18%	27%
None	60	29 = 48%	100%	40	26 = 65%	100%

(1928) recommends five pounds of lead arsenate to 1000 square feet of surface worked into the soil to a depth of ½ inch. It is necessary to add lead arsenate to future top dressings of soil. However, pot experiments with a limited number of larvae with poisoned soil indicate that 2.5 grams of lead arsenate per liter of soil is the minimum effective amount for the Asiatic beetle, and this is equivalent to 2.6 pounds per 100 square feet mixed into the top 2 inches. These experiments also show that the larvae of the first instar are more susceptible to this poison than are older larvae. The results of these pot experiments are given in Table 11, Flower pots having a diameter of six inches across the top were used, and ten larvae were placed in each pot. One control was kept for each lot, the soil not being poisoned. The mortality in this control was possibly due to handling and change of environ-

*The relative survival has been computed by dividing the number of survivals in each test by the number of survivals in the controls.

ment, the larvae being taken from tiles containing growing sod; whereas, the pots contained no living grass. Each experiment was kept the same length of time, and the six lots with first instar larvae and four with second instar larvae were grouped in the compilation of results. There is little difference between the 2.50 grams per liter of soil and 3.00 grams per liter, but a noticeable difference between 2.50 grams and 2.25 grams. Another point worthy of notice is that whereas the larvae of the second instar were kept in the poisoned soil 12-16 days (the same soil was used for first and second instar larvae), they underwent a relative mortality of 77% and an absolute mortality of 85% in the 2.50 gram pots while the larvae of the first instar in the same poisoned soil suffered a relative mortality of 97% and an absolute mortality of 98%. The same general relations between the instars hold throughout the series. The relative mortality is figured on the basis of the survival in the control pots being 100%. The experiments were carried on in August and September, 1927.

This method of adding lead arsenate to the top layer of soil involves the rebuilding of the lawn at the expense of much labor, and a means of safe-guarding lawns in good condition was desired. Since the author above quoted has demonstrated the practicability of top-dressing turf with poisoned soil to protect it against Japanese beetle larvae, it was decided to try this method on the lawns in New Haven for protection against the Asiatic beetle. Two infested lawns were selected and a strip ten feet wide and thirty feet long was laid off on each. Each strip was then divided into three squares of 100 square feet each, the two end squares being treated and the center square serving as a check. In order not to mar the appearance of the lawn, it was decided to apply five top dressings of poisoned soil, each top dressing being one-fifth of one inch in depth, over a period of one year. This would give one inch of poisoned top soil applied to the lawn in the course of the experiment and, since the larvae feed close to the surface, should indicate the degree of protection afforded by the lead arsenate. Top dressings were applied November 10, 1927, and April 18. June 11, and August 15 in 1928. The last treatment was doubled, so that the top dressing was actually applied four times. Each application consisted of the lead arsenate mixed with 2880 cubic inches of soil except the last which consisted of the poison in 5760 cubic inches; 2880 cubic inches covers 100 square feet one-fifth of one inch deep. In no case was the appearance of the lawn marred. Plots were numbered 1, 2, and 3 in the first strip and 4, 5, and 6 in the second. Plot 1 received three ounces of lead arsenate per application, plot 3 received six ounces, and plots 4 and 6 received nine and 12 ounces respectively. At the close of the experiment the 100-foot plots had been given a top dressing of one inch of soil which contained 15, 30, 45, and 60 ounces of lead

arsenate in the respective cases. The two check plots, numbers 2 and 5, received no treatment whatsoever. In all the treated plots the turf remained firm and in plots 3, 4, and 6, comparatively free of larvae. In both check plots the turf was soft, spongy, and well infested. The grass in plots 1 and 3 remained in good condition, whereas, much of that in 2 was killed. In plots 4, 5, and 6, the turf was mainly crab grass *Digitaria (Panicum) sanguinalis,* an annual, so that the appearance of the entire lawn was not good after the first of October. Fertilizer was applied to plots 1, 2 and 3 twice during the summer of 1928, the first time Nitrophoska and the second time ammonium sulfate. Plots 4, 5, and 6 were not fertilized.

October 8 and 9, 1928, diggings were made one foot square and one foot deep in the center of each plot and the number of larvae found were counted. The results are given in the table below. The figures in the last column were obtained by making one digging and, due to the spotted nature of infestations in gen-

TABLE 12—EFFECT OF LEAD ARSENATE APPLIED IN TOP-DRESSING

Plot	Total lead arsenate in 4 applications	Larvae found per sq. ft. Oct. 8, 9, 1928				Larvae per sq. ft. prior to treatment of lawn
		1st Instar	2d Instar	3d Instar	Total	
1	15 ounces....	0	6	7	13	
2	none.....	0	3	46	49	Oct. 11, 1927
3	30 ounces....	0	2	1	3	24
4	45 ounces....	0	0	2	2	
5	none.....	0	6	32	38	Oct. 14, 1927
6	60 ounces....	0	0	1	1	36

eral, may not be exact for the entire area used in the experiments. This also holds true for Table 13.

Observations in the infested area indicate that good turf will withstand an infestation of about 150 larvae per square yard during one season if weather and soil conditions are favorable. From the above results it would appear that two pounds of lead arsenate to 100 square feet is an effective amount, but that one pound may be too little.

An easier method of protecting lawns against injury was tried, the lead arsenate being applied in water, ten to twelve gallons to one hundred square feet, and then washed in with an equal amount of water alone. The required amount of poison was mixed with water in an iron barrel and the resulting suspension applied slowly to the turf with a garden watering can. Before the suspension dried on the soil and grass, an additional ten to twelve gallons of water was applied in the same manner. This washed the poison off the grass and carried it into the ground. It was necessary to work slowly in order to prevent run-off. Four 100-foot plots were laid out, the first three in a row and each 10 ft. x 10 ft., the fourth

on another lawn and 20 ft. x 5 ft. These were numbered 7, 8, 9, and 10 respectively. Plot 11 was the area in the lawn immediately surrounding plot 10. On plot 7 two pounds of lead arsenate were applied, on plot 9, three pounds, and on plot 10 three pounds of colloidal lead arsenate. Plots 8 and 11 were not treated but were used for check plots. The owner of the lawn in which plots 10 and 11 were located applied an inch of soil and fertilizer on plot 11, April 26, 1928, and seeded it. The arsenate was applied to plots 7 and 9 November 10, 1927, and to plot 10 April 18, 1928. The experiment was allowed to run until October 8-9, 1928, when the plots were examined for larvae in the same manner as were plots 1 to 6 above mentioned. Two ounces of casein-lime were added to the arsenate applied to plots 7 and 9, but this may not be necessary in view of laboratory experiments, and it may conceivably be detrimental. Plots 7, 8 and 9 were in the same lawn as plots 4 to 6 above and the turf was mainly crab grass, so that after October first none of these plots looked well as far as the appearance of the grass was concerned, although they could be easily distinguished from the check plots. The sod in the treated plots was firm, however, and comparatively free from larvae, whereas the sod in plot 8, the check plot, was soft, spongy, and well infested. Plot 10 maintained a fair turf as far as the appearance of the grass was concerned and plot 11 resembled plot 8, being soft and having very little live grass. Diggings made as previously October 8 and 9, 1928, gave the following results:

Table 13—Effect of Lead Arsenate Applied in Water.

Plot	Lead arsenate applied*	Larvae found per sq. ft. Oct. 8, 9, 1928 1st Instar	2d Instar	3d Instar	Total	Larvae per sq. ft. prior to treatment of lawn
7	2 lbs.....	0	1	9	10	Oct. 14, 1927
8	none.....	1	8	64	73	
9	3 lbs.....	0	0	1	1	36
10	3 lbs..... (colloidal)	0	1	0	1	?
11	none.....	0	2	36	38	

From the above results it seems that two pounds is only fairly effective when applied in this manner, but three pounds is very satisfactory. In none of these plots was the grass visibly injured by the treatment. It should be borne in mind that all the experimental plots, due to previous infestations of larvae, contained much crab grass, and a fair turf was the best result obtainable as regards the *immediate condition* of the lawn. Where the lawn is already in good condition, it will stay so after treatment.

The method of applying lead arsenate in water was checked by a laboratory experiment in which a shallow box was divided into

*See page 656 regarding this column.

four compartments each one foot square and five inches deep. Each compartment was filled with soil to a depth of three inches and seeded with red top grass. When the grass was about one inch in height, the required amount of lead arsenate was mixed with 500 cc. of water and applied to the one square foot of surface. No additional water was used to wash in the arsenate because of the danger of flooding and getting an uneven distribution of poison. In each plot 100 first instar larvae collected in the field were placed between one and two weeks prior to the application of the poison. The larva were placed in the plots August 1-2, 1928, the lead arsenate was applied August 8-13, and the soil was sifted and examined for larvae September 18-19, 1928. This experiment was carried on in the laboratory. Three plots were treated with arsenate, 7 grams, 14 grams, and 21 grams respectively, and one plot was treated with tap water only, serving as a check. The results are given in the table below:

TABLE 14—EFFECT OF LEAD ARSENATE APPLIED IN WATER.

Lead Arsenate	Applied	Larvae in	Larvae recovered Sept. 18–19				Survival	
			1st	2d	3d	total	Absolute	Relative
None...	Aug. 13 (water)	100 Aug. 1	3	23	55	81	81%	100%
7 grams	Aug. 8	100 Aug. 1	1	6	9	16	16%	20%
14 grams	Aug. 13	100 Aug. 1	3	0	1	4	4%	5%
21 grams	Aug. 13	100 Aug. 2	0	1	3	4	4%	5%

Fourteen grams per square foot is equivalent to 49.4 ounces per 100 square feet, and this appears to be the minimum effective dose. All of the grass in these four plots was affected by damping off, so that the effect of the arsenate on the turf itself could not be determined. In preparing South German creeping bent sod for use on terraces no injury to the grass was visible after treating in the above manner, and at present this appears a safe method. Other lawns in New Haven have also been so treated without visible injury.

It is not known how long the lead arsenate will remain in the soil in effective amounts nor whether or not there will be an accumulation of lead due to these treatments. The field plots 7, 8, 9, 10, and 11 were sampled April 17, 1928, and the soil analyzed for arsenic content, the first three inches of soil being used. The same plots were again sampled in a similar manner October 4, 1928, and again analyzed for arsenic. The determination of the per cent of arsenic should give an indication of the distribution of the poison throughout the top three inches of the soil and of the rate at which the lead arsenate is breaking down and being removed by water from the surface layer. This determination might not be a reliable index of the toxicity of the poisoned soil to the larvae, since this depends somewhat on a number of factors

concerning which there is little available information, nor would it indicate the arsenical compound present in the soil. The results are given below:

TABLE 15—ARSENIC IN SOIL AFTER TREATMENT.

Plot	Lead Arsenate	Applied		As_2O_5* Apr. 27, 1928	As_2O_5* Oct. 4, 1928	Ph Oct. 4, 1928
7	2 lbs. + 2 oz. casein lime in water	11-10-27	1″	0.081%	0.087%	6.21
			2″	0.008	0.009	6.02
			3″	0.005	0.010	6.45
8	none—water only, check on 7 and 9	11-10-27	1″	0.005	0.000	6.80
			2″	0.001	0.005	6.49
			3″	0.000	0.000	6.09
9	3 lbs. + 2 oz. casein lime in water	11-10-27	1″	0.070	0.070	6.31
			2″	0.017	0.006	6.29
			3″	0.003	0.005	6.08
10	3 lbs. colloidal in water**	4-18-28	1″	0.128	0.035	5.40
			2″	0.001	0.017	5.61
			3″	0.012	0.001	6.00
11	none—check on 10		1″	0.005	0.003	5.59
			2″	0.001	0.006	5.55
			3″	0.012	0.000	5.65

The analyses were made on an air-dry basis by the Gutzeit method, and the soil samples were all taken from plots which were treated with a suspension of lead arsenate in water. Three samples were taken from each plot and mixed together to get the plot sample. In getting the soil sample, a cylinder of soil was removed and the upper three inches cut into three one-inch slices. The analyses were made for each of the first three inches of soil. The colloidal lead arsenate was procured from a New York agent of the manufacturer and is much more finely ground, although less bulky, than the commercial acid lead arsenate used in the first two plots (7 and 9). The collodial form also stays in suspension in water longer than the other. The reason for the great decrease in arsenic in the soil poisoned by the colloid form of lead arsenate may be due to the nature of the soil or of the arsenate. Plots 10 and 11 were in one lawn and plots 7, 8, and 9 in another, and in the former case the acidity was much greater than in the latter. The analyses also show less arsenic in the plot treated with three pounds (9) than in the plot treated with two (7), a matter for which the explanation cannot be satisfactorily given at present. The important facts of the analyses are, however, that there was no appreciable decrease in the arsenic content of the soil in plots 7 and 9 during one season, and that in the acid soils of the kind

*Analysis by Mr. H. J. Fisher of the Chemistry Department.
**This colloidal lead arsenate contains 27.06% As_2O_5, 2.16% water soluble As_2O_5, 59.96% PbO.

used in the experiment the addition of lead arsenate caused very little permanent increase in acidity.

The results of these experiments indicate that if the lawn is to be treated by lead arsenate suspended in water and applied as indicated, or by mixing the lead arsenate in the top two inches of soil, then three pounds per 100 square feet of lawn is the most efficient amount of poison to be used. For top dressing the lawn with poisoned soil, two-thirds of this amount, or two pounds per 100 square feet in one inch of top dressing, is best. The successful use of less poison in top dressing is probably due to the greater concentration of poison in the top inch of soil where it is most effective. When applied in water, much of the poison probably remains on the surface of the soil and is not there available. No experiments have been carried on wherein the lead arsenate was mixed with the upper inch or half-inch of soil, but in view of the results attained by top dressing, it would seem advisable to reduce the poison to two pounds per 100 square feet and work it into the top inch when the lawn is being rebuilt. An analysis of the soil of a lawn treated by mixing the arsenate in the upper two inches, three pounds to 100 square feet, showed 0.070% $As_2 O_5$ in the upper inch, 0.046% in the second inch, and 0.017% in the third inch five months after treatment. Granting an equal relative decrease in arsenic in each of the upper two inches of soil, it appears that under field conditions the upper inch receives about three-fifths of the arsenic by this method of treatment. The mechanical difficulties of mixing arsenate in the soil by this method preclude an even distribution in both the upper inches. This lends support to the conclusion that two pounds of lead arsenate mixed in the upper inch are enough. The larvae feed close to the surface of the soil and no poison is necessary below a depth of one inch.

Although it may be possible to still further modify this method according to the recommendations of Leach (1928) given above, since the experiments in New Haven cover one season only, whereas the work of the above author covers a number of years, such modification is not recommended for the Asiatic beetle at present.

Among other chemicals tried against the larvae were potassium xanthate, Semesan*, Uspulun*, Uspulun Nu-Green*, and potassium sulfocarbonate. None of these materials proved effective in the brief experiments carried out, but potassium sulfocarbonate merits further trials.

*Semesan and Uspulun contain 30% hydroxymercurichlorophenol sulfate, and Uspulun Nu-Green contains 15% of the same compound. The remainder of each of these three materials is inert matter.

Recommendations for Control in Lawns

If the lawn is in good condition and it is desired to protect it against future attacks by the larvae, arsenate of lead suspended in water, three pounds to about 12 gallons for each 100 square feet, should be applied before August 1. The lawn should be sprinkled with the suspension slowly and evenly so that it soaks in without puddling or running off. Before the suspension dries on the grass and soil, an additional 12 gallons of water should be applied in the same manner to the same area. If the ground slopes or is uneven so that the suspension runs off or collects in pools, the lead arsenate should be mixed with a small amount of very slightly moist (not wet) earth and spread evenly over the surface. If it is desired to top-dress the lawn, apply the top dressing at the rate of six ounces of lead arsenate to each 2,880 cubic inches (=12.5 gallons or 1.34 bushels) of top-dressing on each 100

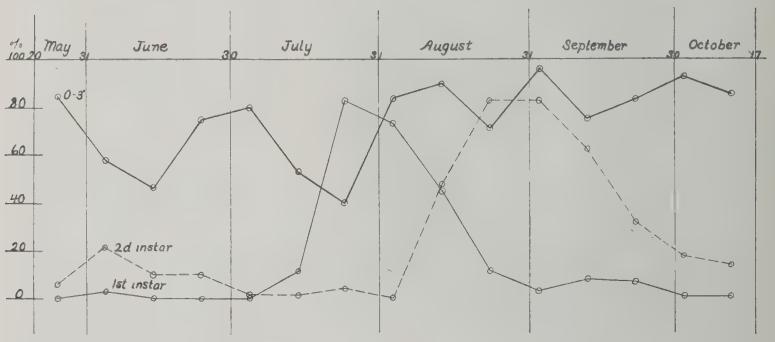

Fig. 56. Larvae in upper three inches of soil and in first and second instars.

square feet. Five applications should be made, and it is advisable to have an inch of top dressing on by August 1. The interval between applications depends on the rapidity with which the grass grows.

In Figure 56 are given the curves showing per cent of larvae above a depth of three inches in the soil throughout the growing season and the percentages of larvae in the first and second instars. These curves are superimposed in order to show the necessity for treating the lawns by August 1. On August 15, or thereabouts, 90 per cent of the larvae are in the upper three inches of soil; between 40 and 44 per cent are in each of the first two instars. This means that practically all the eggs are hatched and the larvae are feeding near the surface of the soil at this time. The younger larvae are much more easily killed than the older larvae, and the treatment should be applied with this fact in mind. Also it is quite evident from field observations that the grass is not severely injured before August 1.

If the grass has been killed by the larvae, it is advisable to spade up the lawn in order to get rid of the weeds and insure a good turf. After spading, smooth the lawn with a rake and apply two pounds of lead arsenate to each 100 square feet. In order to get an even distribution of poison the arsenate should be applied by sifting through a 14-mesh screen, but if a wind is blowing, better results are obtained by thoroughly mixing it with a small amount of slightly moist earth (*not wet*) and spreading the resulting mixture. After spreading evenly, work the material into the ground to a depth of one inch with an iron rake, smooth over and seed. Where the infestation of larvae is not too heavy, good control might be effected by raking over the infested area in the spring, seeding it, and then, after the grass is growing well, applying lead arsenate in water in the manner described above. There is, however, the likelihood that the larvae will kill off this grass before it gets a good start and that weeds will crowd out the lawn grasses. One treatment with arsenate of lead should last several years, although the experiments with the Asiatic beetle have covered one season only. The soil analyses given on page 656 indicate that the arsenate is removed from the soil very slowly. Any top-dressings applied to the lawn should contain lead arsenate in the proportions given.

Carbon disulfide emulsion, containing 70 per cent carbon disulfide, diluted 200 times with water and applied at the rate of three pints of diluted material per square foot of lawn surface will kill the larvae if they are within two or three inches of the surface when the lawn is treated. This treatment should be applied the latter part of August and the soil should not be extremely dry nor yet full of water. The use of this material has several drawbacks. It is but a temporary treatment at best and its effect is over in a short time. If care is not used it will severely injure the grass, and it cannot be stored near fires or hot pipes, being highly explosive. A miscible carbon disulfide is now on the market and is a very superior product as regards keeping qualities, not being injured by cold weather and long storage. It contains 70 per cent carbon disulfide and is used as above indicated. The use of carbon disulfide is fully described by Leach, Lipp, and Fleming (1927).

If the lawn slopes so steeply that it is not feasible to seed it, poisoned turf should be used to replace that injured. The turf may be poisoned a few weeks prior to the time when it will be used by a suspension of lead arsenate in water applied as described above. Cut the poisoned turf into sections and lay it in the lawn in the usual manner.

Fertilization and Seeding

Fertilizer should be applied after the lawn is treated with arsenate, and after the grass is growing well if the lawn has been reseeded, as there is danger of injuring the grass if the fertilizer and arsenate are applied at the same time. A week later should be sufficient. Any of the usual lawn fertilizers should give good results, but those high in phosphoric acid should be avoided. In our experiments we have used both ammonium sulfate and a complete fertilizer.

The grass mixtures commonly sold in New Haven for seeding lawns give a good turf on arsenated soils if the soil is fertile. It is best to seed rather heavily. The germination of the seed may be retarded by the arsenate but no permanently injurious effect will result.

Treatment of Nursery Plants

For the treatment of nursery stock, potted plants, and plants with soil about the roots it is best to follow the procedure for the control of the Japanese beetle as given by Leach and his collaborators, Fleming, and Lipp, references to which may be found in the bibliography.

SUMMARY

The Asiatic beetle, first described in 1875 from Japan, was discovered in Connecticut in 1920 and has since been found in parts of New York and New Jersey. The natural spread of this insect is very slow.

A brief review of natural conditions in New Haven is given.

The genus Anomala belongs to the Ruteline Scarabaeidae, and the structural characters distinguishing the larva from other related larvae are described. A brief morphological description is given of all stages of the insect.

In New Haven the great majority of individuals of this species go through a complete life cycle in one year, but a few require two years for the completion of development. The adults emerge from the pupal stage late in June and during July and August and oviposit in the soil at a depth of about six inches. The eggs hatch in three to four weeks and the young larvae move up close to the surface of the soil where they feed on grass roots and decayed organic matter. In September and October the lawns in heavily infested areas are severely injured and the grass in spots completely killed. Late in October and during November the larvae descend into the soil to a depth of about one foot to hibernate, most of them being at this time in the third larval instar. The last of April the larvae come up close to the surface and re-

sume feeding, and the first of June they go down again to a depth of about six inches to pupate. After a prepupal period of about six days they molt and the pupal stage begins. This lasts about two weeks.

There is at present no effective natural control of this insect in New Haven, and reliance must be placed on insecticides. Lead arsenate and carbon bisulfide have given good control in lawns where properly applied. The latter is used in the form of an emulsion containing 70% CS_2 diluted 200 times with water and applied at the rate of three pints of diluted material per square foot of surface. This insecticide is effective for a short time only, however, and lead arsenate gives a more permanent control. This may be applied to the surface of the lawn at the rate of two pounds per 100 square feet of surface and worked into the soil to a depth of one inch. It may be used in a top-dressing of loam at the same rate, or it may be applied as a suspension in water at the rate of three pounds per 100 square feet of surface.

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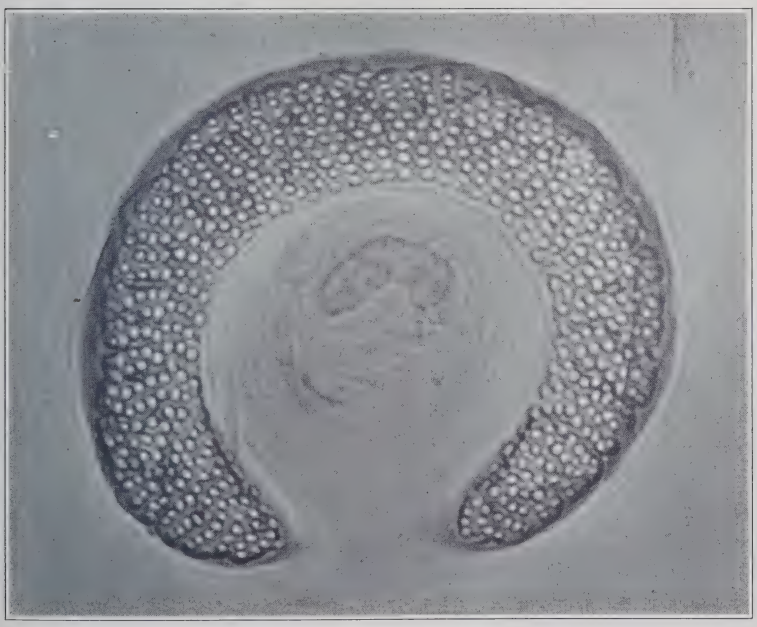
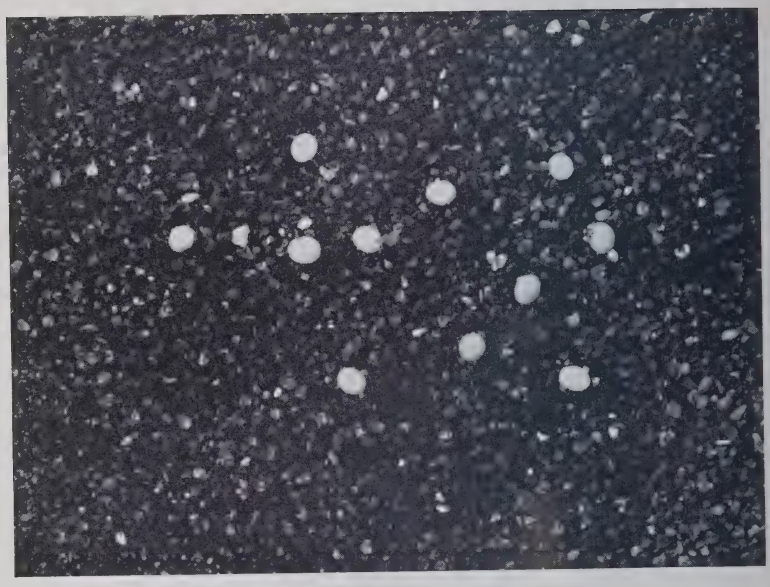
a. Adults of the Asiatic beetle (*Anomala orientalis* Waterh.). Enlarged twice.



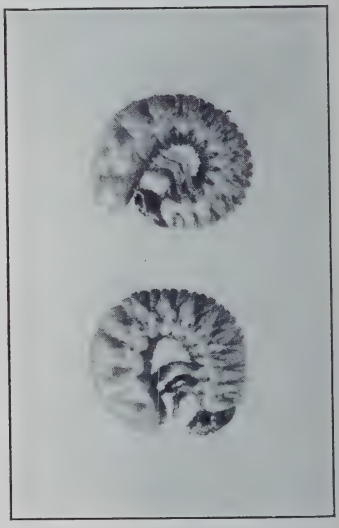
b. Spiracle of larva. Greatly enlarged.

PLATE XVIII



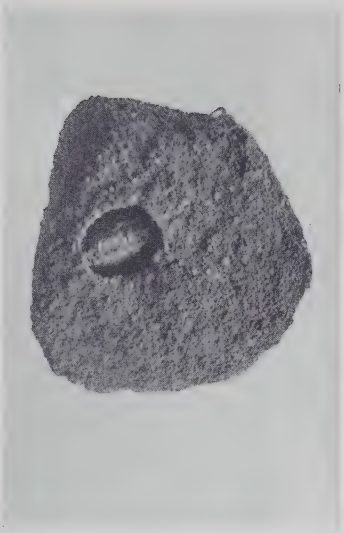
a. Eggs. Enlarged four times.

b. First instar larvae. Enlarged four times.



c. Third instar larvae. Enlarged twice.

a. Prepupa. Enlarged four times.



b. Pupa in cell in earth. Natural size.

c. Pupa in cast larval skin. Enlarged 2.5 times

d. Pupa. Enlarged four times.

PLATE XX

a. Lawn injured by larvae.

b. Holes in ground made by adults.

Bulletin 305 April, 1928

Connecticut Agricultural Experiment Station
New Haven, Connecticut

TWENTY-EIGHTH REPORT

OF THE

STATE ENTOMOLOGIST

OF

CONNECTICUT

1928

W. E. BRITTON, Ph.D.
State Entomologist

The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to other applicants as far as the editions permit.

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AUTHORSHIP

For bibliographical purposes all material in this Report (Bulletin 305) should be credited to W. E. Britton, unless otherwise indicated.

ILLUSTRATIONS

The illustrations in this Report (Bulletin 305) are from the following sources: Figs. 57 and 62, prepared from base maps by B. H. Walden; Fig. 63, from Report for 1911, by A. B. Champlain; all other figures by Philip Garman. The Plates are all from photographs. Plate XXII by W. E. Britton; Plate XXIII, a., by J. Kimport; Plate XXIV, b, and c, from Japanese Beetle Laboratory, U. S. Dept. of Agriculture; Plates XXXII–XXXV by R. C. Botsford; Plate XXXVI, a, by Philip Garman; all others by B. H. Walden.

BULLETIN 305

TWENTY-EIGHTH REPORT

OF THE

State Entomologist of Connecticut

To the Director and Board of Control of the Connecticut Agricultural Experiment Station:

I have the honor to transmit herewith my twenty-eighth report as State Entomologist of Connecticut. Two important projects just completed are not included because the results of each investigation will be published as a separate bulletin. The official inspection and control operations prescribed by statute are given in some detail, and other research work conducted by members of the Department staff is included in this report.

Respectfully submitted,

W. E. Britton,
State and Station Entomologist.

SUMMARY OF OFFICE AND INSPECTION WORK

308 samples of insects received for identification.
245 nurseries inspected.
243 regular certificates granted.
141 duplicate certificates to be filed in other states.
2 special raspberry certificates granted.
104 nursery dealer's permits issued.
261 shipper's permits issued to nurserymen in other states.
237 parcels of nursery stock inspected and certified.
151 bales of mountain laurel and other decorative material inspected and certified for shipment.
45,500 narcissus bulbs inspected and certified.
475 shipments of seed corn inspected and certified.
14,287 certificates on nursery and floral stock and 5,204 certificates on farm products issued for shipments from the Japanese beetle quarantined area.
4,863 certificates issued covering soil and plants from the Asiatic beetle quarantined area.
43 orchards and gardens examined.
26 shipments, containing 277 cases, 2,680,700 plants imported nursery stock inspected.
15 shipments, or 58 per cent found infested with insects.
852 apiaries, containing 8,023 colonies inspected.
9 apiaries and 26 colonies found infested with European foul brood.
36 apiaries and 79 colonies found infested with American foul brood.
3,395 letters* written on official work.

* Including 600 written at the Japanese beetle Quarantine station.

717 circular letters sent out.
244 post cards sent out.
26 reports to Federal Horticultural Board.
1,710 bulletins, etc., mailed on request or to answer inquiries.
201 packages sent by mail or express.
54 lectures and addresses at meetings.

PUBLICATIONS OF THE ENTOMOLOGICAL DEPARTMENT, 1928

By W. E. Britton:

Twenty-seventh Report of the State Entomologist of Connecticut (Bulletin 294), 116 pages, 11 figures, 36 plates, May 1928.

Regulations Concerning the Transportation of Nursery Stock in the United States and Canada. Bulletin of Immediate Information No. 61, 24 pages; 1300 copies, September 1928.

Report of Committee on Injurious Insects, Proceedings Connecticut Pomological Society, 37th Annual Meeting, page 16, July 1928.

Insects Attacking Vegetable Crops in 1927. Report of Committee on Insects, Connecticut Vegetable Growers Association, page 66, June 1928.

The Elm Leaf Beetle, *Tree Talk,* Vol. 8, No. 4, page 32. March 1928.

Some Insect Pests of Cultivated Plants, in *Garden Guide,* 5th Edition, page 293, July 1928.

Oil Sprays and Oil Injury, *Journal of Economic Entomology,* Vol. 21, page 418, April 1928. (Also 300 reprints with Middleton's paper.)

The Fourth International Congress of Entomology, *Journal of Economic Entomology,* Vol. 21, page 651, October 1928.

Book Review: Some Garden Pests, What they are and How to Control Them, by C. T. Gregory and J. J. Davis, *Journal of Economic Entomology,* Vol. 21, page 793, October 1928.

By W. E. Britton and R. C. Botsford:

Anti-Mosquito Activities in Connecticut in 1927, Proceedings Fifteenth Annual Meeting, New Jersey Mosquito Extermination Association, page 146, 1928.

By W. E. Britton and M. P. Zappe:

Some Insect Pests of Nursery Stock in Connecticut, Bulletin 292, 61 pages, 27 figures, 20 plates; 4000 copies, March 1928.

Inspection of Nurseries in 1927, Reprinted from the Report (Bulletin 294) page 210, May 1928.

By M. P. Zappe:

Fighting the Apple Maggot and the Control of Aphis, Proceedings Connecticut Pomological Society, 37th Annual Meeting, page 24, July 1928.

By Philip Garman:

Dusting Menaces Fruit Growers; *Gleanings in Bee Culture,* Vol. LVI, page 293, May 1928.

The European Red Mite, Peach Moth, and Plum Curculio, Proceedings Connecticut Pomological Society, 37th Annual Meeting, page 28, July 1928.

By R. B. Friend:

Book Review: "Shädlings bekämpfung" by Dr. Walter Trapman, *Journal of Economic Entomology,* Vol. 21, page 794, October 1928.

INSECT PEST ACCOUNT

Report of Receipts and Expenditures of the State Entomologist

From July 1, 1927 to June 30, 1928

Receipts

Insect Pest Appropriation, biennial period ending June 30, 1929	$60,000.00
Additions, miscellaneous receipts	27.36
	$60,027.36

Disbursements

Salaries	$15,450.00	
Labor	16,709.25	
Stationery and office supplies	125.35	
Scientific supplies (Chemicals)	42.93	
" " (Other laboratory supplies)	25.61	
" " (Photographic ")	57.38	
Insecticides, etc.	130.67	
Lumber and small hardware	.73	
Miscellaneous supplies	841.64	
Automobile oil	62.31	
Telegraph and telephone	167.74	
Postage	91.22	
Travel expense (Outlying investigations)	2,219.31	
" " (Meetings, Conferences, etc.)	259.53	
" " (Gasoline for automobiles)	507.06	
Freight, express and parcel post	15.33	
Electricity	45.30	
Furniture and Fixtures (New)	180.65	
" " " (Repairs)	19.15	
Library (Books and Periodicals)	201.05	
" (Binding)	82.35	
Scientific equipment (New)	21.48	
Livestock	1.35	
Automobiles (New)	544.00	
" (Repairs)	256.90	
Tools, Machinery and Appliances (New)	48.63	
" " " " (Repairs)	7.10	
New Buildings and Structures	234.24	
Buildings (Repairs and Alterations)	10.58	
Rent of Land and Buildings	314.66	
Insurance (Automobile)	169.47	
Miscellaneous Contingent Expenses	72.44	
Total Disbursements		38,915.41
Balance		21,111.95

DEPARTMENT STAFF AND WORK

W. E. Britton, Ph. D., *State and Station Entomologist.*
B. H. Walden, B.Agr., *Photographic and General Work.*
M. P. Zappe, B. S., *Inspection and General Work.*
Philip Garman, Ph.D., *Research Work.*
Roger B. Friend, Ph.D., *Research Work.*
} *Assistant Entomologists.*

J. F. Townsend
B. W. McFarland
} *Field Technicians.*

J. Peter Johnson, B.S., *Deputy in Charge of Asiatic and Japanese Beetle Quarantines.*
John T. Ashworth, *Deputy in Charge of Gipsy Moth Work.*
James A. McEvoy, *Assistant in Gipsy Moth Work.*
Robert C. Botsford, *Deputy in Charge of Mosquito Work.*
Miss Grace A. Foote, B.A., *Secretary.**
Mrs. Gladys Brooke, B.A., *Secretary.†*
H. W. Coley, Westport
A. W. Yates, Hartford
} *Apiary Inspectors.*

Mr Walden has been in charge of the office during the absence of the Entomologist, and has continued to serve as chief photographer of the department. He has also had charge of certain exhibits for the department and has assisted in the inspection, fruit scoring and in the general work of the department. He has also continued his researches on the imported currant worm, *Pteronidea ribesi* Scop.

Mr. Zappe has continued in charge of the inspection of nurseries and of imported nursery stock. He has also been placed in charge of clean-up work around infestations of European corn borer, in cooperation with the Federal Bureau of Entomology. He has worked with Dr. Garman in the study of the plum curculio in apple orchards during the five-year period 1924-1928 and the results are now ready for publication. With Mr. E. M. Stoddard of the Botany Department, he has visited many orchards to observe pest development and to recommend the time and materials for pest control.

Dr. Garman has continued his investigations on the life history and control of the Oriental peach moth, *Laspeyresia molesta* Busck. He and Mr. Zappe have studied the methods of control for the plum curculio, *Conotrachelus nenuphar* Hbst., in apple orchards and the results will soon be published as a separate bulletin. Dr. Garman has also devoted considerable time to a study of the European red mite and other mites and to the chemistry of insecticides.

Dr. Friend has devoted a large portion of his time to a study of the life history, habits and means of control of the Asiatic beetle, *Anomala orientalis,* Waterh., the results of which are

*Resigned September 1
†Beginning September 1

being published as a separate bulletin. He has also worked with certain insect pests of vegetable crops and has continued the investigations on the life history and habits of the imported birch leaf miner, *Fenusa pumila* Klug.

Messrs. B. W. McFarland and J. F. Townsend have been employed throughout the year as field technicians, the former on Asiatic beetle investigations and control and the latter on curculio and Oriental peach moth investigations under Dr. Garman.

Mr. John T. Ashworth has continued to serve as Deputy in charge of gipsy moth control work with headquarters at Danielson. He has been assisted by Mr. McEvoy and the work has been carried on vigorously and efficiently in cooperation with the Federal Bureau of Entomology.

Mr. J. P. Johnson has continued in charge of the scouting and enforcement of the quarantines against the Japanese beetle and the Asiatic beetle. Mr. Johnson is an agent of the Federal Bureau of Entomology, and since January 1, 1928, has maintained an office in the Hurley Building, Shelton, with a force of men sufficient to make the necessary inspections, issue the required certificates, patrol the principal highways leading out of the quarantined area, and in summer, to scout in other towns and cities in Connecticut outside the quarantined area.

Mr. Robert C. Botsford has continued to serve as deputy in charge of mosquito elimination work. He has made preliminary surveys and has supervised important ditching projects in Branford, East Haven, East Lyme, Hamden, Old Lyme and Saybrook, and has maintained the ditches in the other areas which have been accepted for State maintenance.

Mr. J. Leslie Rogers was employed from June 12 to September 22, Mr. H. B. Bender from July 1 to October 1, and Mr. A. F. Clark from July 5 to August 31, assisting Mr. Zappe in inspecting the nurseries.

Mr. Chas. R. Biecher was employed as temporary laboratory assistant from June 18 to September 1.

Mr. Neely Turner, who is engaged on a project for the Crop Protection Institute on horticultural oil sprays, began work November 10, 1927. Office and laboratory facilities are furnished by the Station.

Miss Grace A. Foote has served as Secretary to the department, but resigned September 1, much to the regret of all members of the staff. Her place has been filled by the appointment of Mrs. Gladys Brooke, who was formerly engaged in similar work at the Texas Station. During the summer vacation period, Mrs. A. D. McDonnell, was employed for part time in order to attend to the necessary correspondence.

Messrs. A. W. Yates, Hartford, and H. W. Coley, Westport. have served as apiary inspectors as in former seasons, on a *per diem* basis.

The Entomologist here expresses his thanks and appreciation to all members of the department staff for the faithful and efficient services which they have rendered. The work accomplished would have been impossible without such help.

The Entomologist has given his personal attention to the office correspondence and has directed the research, inspection, control and quarantine work of the Department. He has also served as chairman of a committee on the project on horticultural oil sprays of the Crop Protection Institute, as Associate Editor of the *Journal of Economic Entomology,* and as Insect Pest Reporter in Connecticut for the Insect Pest Survey of the Bureau of Entomology. He is also chairman of the Tree Protection Examining Board, and Superintendent of the Geological and Natural History Survey of Connecticut, and has devoted some of his time to these matters.

The principal activities of the department are given in detail in the following pages of this report.

ENTOMOLOGICAL FEATURES OF 1928

Following a rather mild winter with light snow fall and not excessively low temperatures, the growing season opened with cool weather and scanty rainfall and the spring development of most kinds of insect life was later than usual. During June, July and August, precipitation was frequent and abundant and higher temperatures prevailed. Perhaps the most outstanding entomological features of the season were the expected appearance of Brood II of the periodical cicada or 17-year locust, the discovery of additional infestations of the Japanese beetle at Hartford, New Haven, New London, and a much larger one at Springfield, Mass., and the extensive spread of the European corn borer.

The writer is indebted to Mr. M. P. Zappe of the Department staff for some of the notes on fruit insects and to Mr. A. E. Wilkinson, Vegetable Specialist of the Extension Department, Connecticut Agricultural College, Storrs, for much of the information regarding the prevalence of insects attacking vegetable crops.

Fruit Insects

The Eastern tent-caterpillar, *Malacosoma americana* Fabr., has now passed the peak of its greatest abundance and is on the wane. Though nests were numerous in some localities, they were less abundant than in 1927 and we expect fewer nests in 1929.

The apple and thorn skeletonizer, *Hemerophila pariana* Clerck, is still present and evidence of its work could be found in nearly every orchard, but it does no real damage. Apparently natural enemies are holding it in check.

The grape-vine flea-beetle, *Haltica chalybea* Ill., caused considerable injury to grape-vines in Glastonbury and Bolton in May by eating off the buds. Cutworms also caused similar injury at Glastonbury May 22, and at Windsor Locks May 14.

A prominent fruit pest in 1928 was the Oriental peach moth, *Laspeyresia molesta* Busck, which caused great injury to peaches and quinces in the central and southern portions of the State. Specimens in quince were received from Meriden, October 1. Wherever peaches are grown commercially, there is usually damage, and as yet no satisfactory remedy has been discovered.

On June 19, specimens were received from Canaan of the comparatively rare Say's blister beetle, *Pomphopoea sayi* Fabr., which was feeding upon peach foliage.

The ever-present codling moth, *Carpocapsa pomonella* Linn., was moderately abundant in 1928, but good control was obtained in sprayed or dusted orchards.

The only evidence seen of the presence of the lesser apple worm, *Laspeyresia prunivora* Walsh, were specimens of injury received from Norwalk, October 29.

The plum curculio, *Conotrachelus nenuphar* Hbst., was very late in emerging from winter quarters but was present in apple orchards in the usual numbers, and caused the characteristic scars on the fruit. Specimens of injury to apple were received from Beacon Falls, July 2; Bridgeport, July 5, and to pear and apple from Norwalk, September 15. In Hamden, from 18-33 per cent of the early maturing larvae were parasitized by *Triaspis curculionis* Fitch, but the average parasitism was only five per cent.

The apple maggot or "railroad worm", *Rhagoletis pomonella* Walsh, was present in about the average numbers and caused some damage, particularly on early maturing sweet and subacid varieties which did not receive the July treatments. Specimens of injury were received from Norwalk, October 29.

The apple budmoth, *Tmetocera ocellana* Schiff., was apparently less abundant than usual.

The red-humped caterpillar, *Schizura concinna* S. and A., feeding on apple foliage was received from Norwich, July 19 and Woodstock, September 18.

The hag moth caterpillar, *Phobetron pithecium* S. and A., was more prevalent than usual, and specimens on apple were received from Meriden, August 21; Shelton, September 18, and on pear from Hartford, August 23.

The fall cankerworm, *Alsophila pometaria* Harris, a pest of orchards, shade and woodland trees, mentioned elsewhere in this report was as usual locally abundant in 1928. Eggs were received from Bridgeport, January 20, and adults from Madison, December 6.

Certain noctuid larvae called green fruit worms and usually of the genus *Xylina* often cause considerable injury by eating into the growing fruit, especially apples. Specimens were received from Bridgeport July 5.

A specimen of the larva of *Sphinx drupiferarum* S. and A., feeding on plum foliage, was received from Torrington, July 27.

The imported currant worm, *Pteronidea ribesi* Scop., though not as abundant as in some seasons, was present, and specimens of larvae were received from New Haven, May 8.

Larvae of the crinkled flannel moth, *Lagoa crispata* Pack., were received September 17, from Saybrook Point, where they were feeding upon raspberry.

The European red mite, *Paratetranychus pilosus* C. and F., was present in average numbers, and caused some injury in certain orchards. Eggs of this mite were received from Bantam, April 9, and from Wallingford, February 25.

Another instance of injury to pears by the quince curculio, *Conotrachelus crataegi* Walsh, was received from Branford, August 6. Probably this pest can be partially controlled by spraying with lead arsenate.

The pear midge, *Contarinia pyrivora* Riley caused injury to pears here and there. Specimens were received from Wallingford and New Milford, June 8. No remedy is known other than to gather and destroy the immature pears which will reduce the numbers of the insect the following year.

Leafhoppers, probably *Empoa rosae* Linn., were extremely abundant in apple orchards around Unionville and Southington. Later in the season at Unionville many were killed by a fungous disease.

The pear *Psylla pyricola* Forst., caused less damage than in 1927, though present throughout the State, and was rather abundant in some orchards around New Haven, Stamford, and Wallingford.

Another insect which was absent from most orchards was the apple redbug, *Lygidea mendax* Reut. This insect was observed by our entomologists only at Kensington and Unionville.

An unusual form of injury to peach fruits was observed at the Station, where peach trees are near some oak trees. The fruit was badly punctured by the oak plant bug *Lygus quercalbae* Knight.

Apple aphids (both green and rosy) were rather scarce and caused little injury to fruit.

The woolly apple aphid, *Eriosoma lanigerum* Hausm., was present in usual numbers. The characteristic galls caused by this insect were received from Bridgeport, January 20; Wallingford, February 25, and Noank, June 20.

The currant aphid, *Myzus ribis* Linn., was present as usual and caused the terminal leaves to become blistered or curled. Specimens were received from New Haven, May 10.

The San José scale, *Aspidiotus pernicosus* Comst., was comparatively scarce, and though found in 30 different nurseries, there seems to be no injury from this insect in well-conducted orchards.

The European fruit scale, *Lecanium corni* Bouché, which may attack a variety of trees and shrubs was received on grape-vine from Bridgeport June 5, and New Haven, August 31.

Vegetable Insects

Cutworms were prevalent throughout the State and caused injury to vegetable crops. Damage was reported from Norwich, April 11, Brooklyn, Canterbury, Danielson, Hampton and Wauregan, May 14, and Woodstock May 15. Some growers have used a poisoned bran mash, and their plants were not badly damaged.

The corn ear worm, *Heliothis obsoleta* Fabr., was scarce or absent from most fields of late maturing corn. Not a single report of the appearance of this insect was received at the Station.

The stalk borer, *Papaipema nitela* Guen., seems to be present each year. In 1928 it was rather more abundant than usual and was reported in corn from Wethersfield, July 18, Madison, July 24, Meriden July 35, Thomaston, August 21. It was received in pepper from Stafford Springs, July 20. It was very destructive to corn in a small section of Wethersfield.

The asparagus beetle, *Crioceris asparagi* Linn., is also prevalent nearly every season throughout the State. Reports were received as follows: Farmington, May 21; Huntington where one-third of the crop was seriously injured, June 5; Ridgefield and vincinity, June 6; Thompsonville, Bristol and Southington, June 14.

The striped cucumber beetle, *Diabrotica vittata* Fabr., caused the usual amount of injury throughout the State. At the Station farm at Mount Carmel, it was more amundant and destructive than in 1927.

A troublesome pest of potato and tomato plants is the potato or cucumber flea beetle, *Epitrix cucumeris* Harris, and the season of 1928 was no exception in this regard. The following reports of injury were received; Green's Farms District, June 5; Ridgefield and Danbury region, 10 acres inspected, 10,000 plants injured June 6, Litchfield County, Bethlehem, Morris, Northfield, Thomaston, Watertown and Winchester, tomatoes and potatoes, June 7.

Cabbage insects were abundant during the season. The imported or green cabbage worm, *Pontia rapae* Linn., was so

destructive to cauliflower that one of the largest growers discontinued growing the crop for the season.

The cabbage looper, *Autographa brassicae* Riley, was also present and also contributed toward the damage.

The diamond-back moth, *Plutella maculipennis* Curtis, was present in nearly every cabbage field in New London, Tolland, and Hartford Counties, and caused some injury.

In a field at Norwich, investigated May 10 by Dr. Friend, the cabbage plants had been considerably injured by the horseradish flea beetle, *Phyllotreta armoraciae* Koch. Horseradish had been grown on the field the preceding year. Spraying with lead arsenate will probably control all of the four insects just mentioned.

Specimens of the cabbage curculio *Ceutorhynchus rapae* Gyll., were in the stems of cabbage plants from Orange, June 21. This insect usually breeds in hedge mustard, Shepherd's purse, and wild pepper grass.

Probably the most serious injury to cabbage plants was caused by the cabbage maggot, *Hylemyia brassicae* Bouché. Injury was reported as follows: Mount Carmel, Foxon, and Westville, May 21; Westport, June 6; New London County, June 13; Bristol, Southington and Thompsonville, June 14; Orange, June 21. At Southington 4,000 out of 6,000 plants were destroyed, but the remainder were saved by treating with corrosive sublimate. At Bristol, two applications of corrosive sublimate gave good control, and without the treatment only one plant remained out of fifty.

Cauliflower plants at Southington were injured by a species of thrips, probably the tobacco thrips, *Thrips tabaci* Linde. Mr. Walden visited the field September 14, and advised dusting with nicotine dust.

The cabbage aphid, *Brevicoryne brassicae* Linn., was not generally prevalent during the season, but a few specimens were received from Orange, June 21.

The carrot rust fly, *Psila rosae* Fabr., is evidently becoming more prevalent as its work is now frequently observed on carrot and parsnip in the markets. Specimens were received from Norfolk, April 5, and October 1.

The spinach leaf miner, *Pegomyia hyoscyami* Panz., was not prevalent in 1928. It was present in some fields in June but entirely disappeared later.

The gray field slug, *Agriolimax agrestis* Linn., was reported as injuring tobacco plants in seed beds, June 27.

In general aphids were not very troublesome in 1928, on vegetable crops and not a single report was received of injury by the pea aphid, *Illinoia pisi* Kalt., or by the potato aphid, *Macrosiphum solanifolii* Ashm.

The European corn borer, *Pyrausta nubilalis* Hubn., has spread rapidly during the season and was found by Federal scouts in some 25 towns not previously known to be infested. Most of these are in the eastern end of the State and will be described more fully in another place in this report.

Shade and Forest Tree Insects

Sawfly larvae were rather abundant on conifers during the season. Cocoons of *Diprion simile* Hartig were received from New Haven, April 23; larvae on pine from Hamden August 18 and 25, and from Norwichtown, September 5. *Neodiprion lecontei* Fitch, was more abundant than for several years and was received from Greenwich on two-needled pine September 28. In Branford, Plainville and Unionville, many small pitch trees were completely defoliated but on the larger trees, some leaves remained. *Neodiprion pinetum* Norton was received from North Stonington October 5.

The elm sawfly, *Cimbex americana* Leach, was received from Danbury and Watertown, August 27, and from Norfolk, September 20. Spraying with lead arsenate is the remedy if any of the sawflies mentioned above become injuriously abundant.

The white-marked tussock moth, *Hemerocampa leucostigma* S. and A., in its larval stage feeds upon various deciduous trees. A larva of this species on maple was received from Litchfield, August 13. The tessellated tussock moth, *Halisidota tessellaris* S. and A., was received on sugar maple from New Haven, August 31. The former often defoliates trees particularly in towns and cities. Spraying with lead arsenate is the remedy.

The fall cankerworm, *Alsophila pometaria* Harris, was very abundant in woodland areas in Ridgefield in 1928, and there was an area of several hundred acres just west of the mouth of the Connecticut River, where the woodland trees were almost completely defoliated. Of course, spraying with lead arsenate will prevent defoliation.

The green elm leaf beetle, *Haltica ulmi* Woods, was very abundant at Sound Beach late in the season and the adults could be gathered by the pailful. Specimens were received December 6. Spraying with lead arsenate is the remedy.

The pine tube maker, *Eulia pinatubana* Kearf., has the peculiar habit of fastening together the needles in a cluster to form a protecting case for the larva which devours the distal portion of the needles. This insect was received from New Haven, August 31. In case of severe attacks, the remedy is to spray with lead arsenate.

The fall webworm, *Hyphantria cunea* Drury, was very abundant in the eastern portion of the State.

A Chrysomelid beetle, *Dichelonyx elongata* Fabr., feeding upon oak was received from Cos Cob, June 1. This is a rather common species, with feeding habits and injury to foliage similar to those of the rose chafer. A spray of lead arsenate is the remedy.

The imported willow leaf beetle, *Plagiodera versicolora* Laich., has now spread over the entire State, and was observed in 27 different nurseries during the summer Both adults and larvae feed upon the foliage of glossy-leaved species of willow and sometimes on poplar. During the season, specimens of this insect were received from Greenwich, two adults, January 12; West Haven, June 30, and Colebrook, July 3. Spraying with lead arsenate is the remedy.

Curious balls of frass are often noticed on pine branches. These balls are often two inches or more in diameter, though sometimes smaller. Inside the ball in silken tubes are light brown larvae with darker brown stripes running lengthwise. The adult of this insect is a brown moth, *Tetralopha robustella* Zeller, a species formerly considered rare, but which now seems to be rather common. Specimens of larvae were received from Hartford, May 7.

During the season several leaf-miners have been brought to our attention. One of the most conspicuous of these is the birch leaf-miner, *Fenusa pumila* Klug, which forms blotch mines in the tender terminal leaves of gray birch, European white birch, and its cut-leaf variety, and to some extent in paper birch. Specimens were received from Norwalk, June 20, and from New Haven, July 24. It was observed in 58 different nurseries and is now distributed throughout the State and probably throughout New England. No remedy or preventive has been discovered.

The blotch oak leaf-miner, *Lithocolletis hamadryadella* Clem., was received from Cromwell, August 7.

The larch leaf-miner or case bearer, *Coleophora laricella* Hubn., has caused injury to the native larches in the swamps and to cultivated trees in parks and on home grounds. The larva is a miner inside the leaf. Trees which are severely infested present a very ragged appearance. Specimens of the winter cells were received from Stamford, October 16. These winter cases are fastened to the twigs throughout the winter. The remedy is to spray during the first week of April, using liquid lime-sulphur, diluted at winter strength, one part in nine parts water.

A leaf-miner of spruce, *Recurvaria* sp. was received from Hartford, February 29.

The arborvitae leaf-miner, *Argyresthia thuiella* Pack., which caused so much injury around New Haven in 1920-1922 is now present in injurious numbers in a region just South of Waterbury, and specimens were received from Union City, May 24. There is

no good remedy but some measure of control will result in spraying with nicotine solution and soap, the last week of May and the first week of June, when the adults are flying about and depositing eggs.

Two species of mites have been prevalent during the season and injured or disfigured trees. The spruce mite, *Paratetranychus ununguis* Jacobi, is found on spruce and other conifers, and often causes serious injury. The individuals feed upon the leaves causing them to turn gray or brown and often web together the leaves and twigs. We have been recommending a spray of linseed oil emulsion, but expect to carry on tests of other sprays next season to ascertain a better method of control. Specimens of this mite were received on spruce from Clinton, August 8, and on arborvitae from Bridgeport, October 10; Lyme, October 13, and Newtown, October 16.

The other mite, *Phyllocoptes quadripes* Shimer, forms galls on leaves of silver maple, called the maple bladder gall. Specimens were received from Cromwell, May 23; New Canaan, May 29; Hartford, June 14; Wethersfield, June 19, New Hartford, June 25; Waterford, July 27, and Woodmont, August 10. According to Herrick*, a dormant spray of liquid lime-sulphur 1-8 in April proved to be an effective remedy.

Certain insects form galls on shade and forest trees and may be mentioned here. The horned oak gall, *Andricus cornigerus* O. S., was received from Woodbridge, June 21. The oak pea gall, *Philonix pezomachoides* O. S., was received from Cromwell August 7. The oak fig gall, *Biorhiza forticornis* Walsh, was received from Niantic, August 11. A psyllid gall, *Pachypsylla celtidis* Riley, on hackberry was received from Fairfield, July 10. A rather large aphid gall, *Pemphigus ulmifusus* Walsh, on slippery elm was received from Short Beach, Branford, July 11, and the vagabond poplar gall, *Pemphigus vagabundus* Walsh, on poplar was received from Middletown, July 26.

Other aphid galls which have been common are the spruce gall, *Adelges abietis* Linn., found in 75 different nurseries, and the blue spruce gall, *Gillettea cooleyi* Gillette, found in 45 different nurseries. Specimens of the former on Norway spruce were received from Riverside, November 5, and specimens of the latter on Colorado blue spruce were received from New Canaan, June 7, August 6, and September 8; New Haven, June 18; Waterford, July 27; Middletown, August 27; Bridgeport, September 15, and Stamford, October 16. Both these species may be controlled by spraying between April 1-15, with a contact spray such as a miscible oil (1-25) or a nicotine soap solution to kill the over-wintering females on the twigs.

*Journal of Economic Entomology, Vol. 18, p. 632, 1925.

Two aphid galls were received on hickory. The hickory leaf stem gall aphid, *Phylloxera caryaecaulis* Fitch, was received from West Haven and Norwalk, June 20. Another species, *Phylloxera rimosalis* Pergande, was received from New Haven, June 12. Both species make galls on the leaf petioles. Remedies have not been worked out.

The pine bark aphid, *Adelges pinicorticis* Fitch, which is responsible for the appearance of cotton or wool on the twigs and bark of white pine was received from Lyme, May 10; Bridgeport, August 6, and New Haven, August 31.

A large aphid, *Longistigma caryae* Harris, was received on hickory from Norwich, September 12.

The pine spittle bug, *Aphrophora parallela* Say, was common in midsummer and formed frothy masses or spittle balls on pine twigs. Specimens were received from Bristol, July 7.

A leafhopper, *Idiocerus scurra* Germar, was reported as being very abundant on a Lombardy poplar tree in New Haven, August 10, and specimens were brought to the Station.

Several species of scale insects were common on shade trees in 1928. The oak gall scale, *Kermes* sp., was received from Cromwell, August 7. The pine leaf scale, *Chionaspis pinifoliae* Fitch, was received from Southington, May 18. The white elm scale, *Chionaspis americana* Johnson, on elm was received from New Haven, February 23. The cottony maple scale, *Pulvinaria vitis* Linn., is rather common on red and silver maple in certain regions. Specimens were received from Hartford, June 29; West Haven, June 30; East Hartford, July 17, and Sound Beach, July 23. The tulip tree scale, *Toumeyella liriodendri* Gmel., was rather abundant during the season on tulip tree and magnolia. Specimens were received on magnolia from New Haven, July 25, and Hamden, September 13, and on tulip tree from Waterbury, August 28, and Georgetown, October 23.

The white pine weevil, *Pissodes strobi* Peck, continues to cause great injury to specimen trees and forest plantings where the young trees are not shaded. Specimens were received from Portland, June 8; Somers, July 17, and Westport, August 13. A closely related species, *Pissodes approximatus* Hopkins, seemed to cause the death of red pines planted in Goshen.

A bark borer, *Phloeosinus dentatus* Say., was received in red cedar from Greenwich, March 30, and in red cedar and arborvitae from West Cornwall, September 24.

The hickory bark beetle or bark borer, *Scolytus quadrispinosus* Say., was received from Cos Cob, March 23. The hickory borer, *Cyllene caryae* Gahan, was received from Suffield, May 7.

The twig pruner, *Hypermallus villosum* Fabr., was received from Mystic, August 3, and Watertown, August 15. Another common twig borer, *Phymatodes variabilis* Fabr., was received from Stamford, May 25.

The poplar and willow curculio, *Cryptorhynchus lapathi* Linn., was received from West Haven, June 30 and July 2.

The pigeon horn-tail, *Tremex columba* Linn., was rather abundant in dying trees in Meriden, and specimens were sent to the Station, September 14.

The leopard moth, *Zeuzera pyrina* Linn., was received from East Haven, November 14, 1927.

The European pine shoot moth, *Rhyacionia buoliana* Schiff., is becoming prevalent in red Scotch, and other pines in various regions of the State. Specimens were received in either Austrian or Caucasian pine from Rainbow, November 23, 1927, in Scotch pine from Hartford, May 7, and from Norfolk, September 17, in red pine from Hampton, August 30, and from Stamford, October 16. A closely related species, *Evetria comstockiana* Fern., in pine was received from Bristol, July 7.

The periodical cicada or 17-year locust, *Tibicina septemdecim* Linn., appeared in Connecticut as expected and caused some injury to shade and woodland trees where eggs were deposited in the twigs and branches. Some of these twigs break off and there were small areas around Meriden and New Britain and probably in other sections of the State where the hillsides were brown in July and following, from the broken branches.

Insects Infesting Ornamental Shrubs and Vines.

The juniper webworm, *Dichomeris marginellus* Fabr., has been very prevalent and the larvae webs together the leaves on a twig and feeds upon the leaves inside the web. It is more apt to injure plants of the low juniper *Juniperus communis* and the Irish juniper variety *hibernica,* than the common red cedar *Juniperus virginiana.* Specimens were received from New Haven, April 23, and Newtown, June 29. An affective remedy consists in thoroughly spraying the foliage with lead arsenate. A similar injury to blue spruce was caused by the larvae of a noctuid moth, *Epizeuxis aemula* Hubn., at Woodmont, early in July.

The privet leaf roller, *Archips rosana* Linn., was unsually abundant in certain localities around New Haven, and one hedge presented a very ragged appearance where partially defoliated. Specimens were received from New Haven, June 5 and 7. The oblique-banded leaf roller, *Archips rosaceana* Harris, was also very prevalent and caused injury to roses in many gardens. Specimens were received from New Haven, June 14. Spraying with lead arsenate is a remedy for both these leaf-rollers.

The eight-spotted forester, *Alypia octomaculata* Fabr., feeding upon Virginia creeper was received July 13. Several larvae were nearly full grown. Grapevines and Virginia creeper were nearly stripped in two sections of New Haven. This insect may be controlled by a spray of lead arsenate.

The rhododendron borer, *Sesia rhododendri* Beut., was received from Plantsville, August 30.

The oyster-shell scale, *Lepidosaphes ulmi* Linn., is commonly found on lilac, often killing certain stems or branches. Specimens were received from New Haven, February 23, and from Hamden, September 13.

One of the mealy flatas, *Ormenis pruinosa* Say., is often rather abundant on privet, Japanese barberry and other ornamental plants, though it is questionable whether it causes much injury. Specimens were received from Norwalk, August 13.

The witch hazel cone-gall aphid, *Hormaphis hamamelidis* Fitch, is responsible for the cone-shaped galls on the upper surface of the leaves of witch hazel. Specimens were received from Essex, June 21.

The azalea scale, *Eriococcus azaleae* Comst., is rather common at times on azalea and rhododendron around New Haven. Specimens were received from Hartford, June 4, on rhododendron.

The rose weevil, *Rhynchites bicolor* Fabr., was unusually abundant and injured many rose gardens by eating into the sides of the buds. Specimens were received from New Haven, July 17.

Climbing cutworms, *Xylina* sp., also injured rose buds by eating into them. The writer observed this type of injury in his own garden and specimens were received from Hartford, June 20.

The rose chafer, *Macrodactylus subspinosus* Fabr., was present in most gardens though not as abundant as in some seasons. The beetles feed upon grape and other foliage and upon white rose and paeony flowers. Specimens of the grubs were received from Westport, April 27, and adults from New Haven, June 30.

Insects Attacking Flowers and Greenhouses Plants.

Two mites are common pests of greenhouse plants. One is the bulb mite, *Rhizoglyphus hyacinthi* Banks, which was received from Hartford, March 14, infesting Bermuda lily. The other is known as the cyclamen mite, *Tarsonemus pallidus* Banks, though it injures a number of other kinds of plants both in the greenhouse and in the garden out-of-doors. Specimens were received on larkspur from Hartford, March 20, and New Haven, June 16, and on snapdragon from New Haven, October 29.

The greenhouse whitefly, *Trialeurodes vaporariorum* Westwood, is troublesome on certain plants in dwellings, greenhouses, and even out-of-doors in the summer, throughout the state. Specimens were received on Pelargonium from Norwichtown, May 25. The remedy is cyanide fumigation or a contact spray like nicotine solution and soap.

The four-lined leaf-bug, *Poecilocapsus lineatus* Fabr., often injures various garden plants by sucking the sap from the tender

terminal leaves, causing transparent circular spots and later holes to appear in them. Specimens were received on chrysanthemum from New Haven, June 21, on chrysanthemum and dahlia from Bridgeport, July 9, and on aster, ageratum and *Dianthus* from Orange, July 13. The remedy is frequent spraying during June, with nicotine solution and soap.

Dahlias are also injured by the tarnished plant bug, *Lygus pratensis* Linn., and specimens were received from Eastford, August 14. This bug causes a distortion or dwarfing of the injured shoots, but transparent spots or holes do not follow. The remedy given above should prove effective.

Climbing cutworms were reported as injuring dahlias at Hartford, August 2. One species, *Peridroma margaritosa*, var. *saucia* Hubn., caused considerable injury to carnations in Bridgeport, by eating into the buds. Specimens were received January 20.

The greenhouse leaf-tyer, *Phlyctaenia ferrugalis* Hubn., caused much injury to chrysanthemums in the greenhouse at Elmwood. Specimens were received May 14 and from New Haven, May 24, on heliotrope. Cyanide fumigation of the house or spraying the plants with lead arsenate usually prove effective.

The iris root borer, *Macronoctua onusta* Grote, was received from New Haven, August 13. The larva tunnels in the rootstocks of iris, and should be destroyed whenever found. The adult moth lays late in the fall on the leaves, consequently gathering and burning the iris leaves in early spring is one of the best measures of control.

The zebra caterpillar, *Mamestra picta* Harris, is often a pest of the flower or vegetable garden. The moth lays eggs on the leaves and the young caterpillars begin feeding upon the foliage. Specimens on gladiolus were received from Meriden, July 3.

Insects Injuring Stored Vegetable Products

Stored seeds, cereals and other products are often injured by various insects, some of which are mentioned below.

The black carpet beetle, *Attagenus piceus* Oliv., was received from Hartford, December 27, 1927, in seeds, and again from New Haven, March 20. It is usually as a pest of carpets, rugs and clothing that we hear of this insect, and specimens injuring clothing were received from New Haven March 14.

The museum beetle, *Anthrenus verbasci* Linn., evidently feeds upon both plant and animal products. Specimens were received from Shelton, May 24.. Anthrenus larvae which may have been this species were received from New Haven, March 20, feeding on seeds.

The rice weevil, *Calendra oryzae* Linn., was received from Middletown, December 30, 1927, infesting stored corn.

The cigarette beetle, *Lasioderma testaceum* Dufts., was received in bread, from Hartford, January 17.

The cadelle, *Tenebroides mauritanica* Linn., was received in cocoa beans from Stamford, February 9.

The saw-toothed grain beetle, *Oryzaephilus surinamensiss* Linn., and the confused flour beetle *Tribolium confusum* Duval, were received from Stamford, June 20.

The rice moth, *Corcyra cephalonica* Stainton, was reared by Dr. Friend from cocoa dust from a chocolate factory at Stamford. This is the first record of this insect from Connecticut.

Miscellaneous Insects

White ants, *Reticulitermes flavipes* Koll., often infest and injure structural timbers or wood. This insect in the trim of a schoolhouse was received from Suffield, June 5. On August 22, specimens were brought in from the lobby of a theater in New Haven.

The large American cockroach, *Periplaneta americana* Linn., is often found in dwelling houses where it feeds upon the crumbs and waste food materials around kitchen and pantry. Specimens of nymph and adult were received from New Haven, September 27.

The adults of the Asiatic beetle, *Anomala orientalis* Waterh., were more abundant than in 1927, in the infested area, and many lawns were injured by the grubs. In the spring the grubs came to the surface about April 17, two weeks earlier than in 1927. Treating the lawns with lead arsenate, three pounds to 100 square feet, seems to be the best remedy.

The Japanese beetle, *Popillia japonica* Newman, was found to be present in Stamford and Bridgeport in larger numbers than in 1927. Federal scouts found small infestations in New Haven, New London and Hartford, and a larger infestation in Springfield, Mass., only a few miles from the Connecticut line.

According to a report received June 14, wireworms had destroyed three acres of beans at Thompsonville.

The black cutworm, *Agrotis ypsilon* Rott., was recived from Cromwell, August 28, where it was feeding upon the grass on the golf links.

Some of the most important of these insects are treated at greater length in other portions of this report.

Convention of Entomological Workers

The fifth annual convention of entomologists working in Connecticut was held at the Station on Thursday, October 25, 1928. The program was planned to include subjects of vital interest to

Connecticut entomologists, but the following entomologists from outside the State were invited to present papers: L. H. Worthley, Boston, Mass., Dr. Albert Hartzell, Yonkers, N. Y., A. F. Burgess, Melrose Highlands, Mass., and C. H. Hadley, Camden, N. J. Messrs. Worthley, Hadley, Felt and Johnson could not be present and their papers were read by Messrs. Bartley, Sherman, Spicer and Burke. About 42 attended the meeting. Luncheon was obtained at the Yale Dining Hall. The program was as follows:

PROGRAM

A. M.

10:10 Greetings:
W. L. Slate, Director, Experiment Station, New Haven.

10:15 Progress in Mosquito Ditching in Connecticut in 1928:
R. C. Botsford, New Haven.

10:30 Some Entomological Features of the Season of 1928:
Dr. W. E. Britton, New Haven.

10:45 Some Injurious Shade-Tree Insects in 1928:
Dr. E. P. Felt, Stamford.

11:15 New Phases in the Spread and Control of the European Corn Borer
L. H. Worthley, Boston, Mass.

11:45 Experiments with Oil Mixtures in Killing the Eggs of the European Red Mite:
Dr. Philip Garman, New Haven.

12:00 General Properties of Oil Sprays:
Neely Turner, New Haven.

P. M.

12:15 Naphthalene Fumigation:
Dr. Albert Hartzell, Yonkers, N. Y.

12:30 Luncheon.

2:00 Glimpses of the Fourth International Congress of Entomology held at Ithaca, N. Y., Aug. 12-18:
Prof. J. A. Manter, Storrs.

2:30 The Gipsy Moth and the Satin Moth:
A. F. Burgess, Melrose Highlands, Mass.

3:00 Present Status of the Japanese Beetle in the United States:
C. H. Hadley, Camden, N. J.

3:30 Some Aspects of Japanese Beetle Quarantine Enforcement in Conn.:
J. P. Johnson, Shelton.

3:45 Control of the Asiatic Beetle:
Dr. R. B. Friend, New Haven.

4:00 Notes on Nursery Inspection in Connecticut:
M. P. Zappe, New Haven.

The following were present: J. T. Ashworth, Danielson, Conn.; Harold L. Bailey, Bradford, Vt.; H. N. Bartley, Bridgeport, Conn.; R. C. Botsford, New Haven, Conn.; W. E. Britton, New Haven, Conn.; A. F. Burgess, Melrose Highlands, Mass.; G. W. Burke, Shelton, Conn.; W. A. Collins, New Milford, Conn.; Harry E. Cooke, Torrington, Conn.; O. B. Cooke, Danielson, Conn.; R. G. Cooper, Colebrook, Conn.; S. S. Crossman, Melrose, Mass.; C. M. Emerson, Hartford, Conn.; R. B. Friend, New Haven, Conn.; Philip Garman, New Haven, Conn.; R. D. Glasgow, Albany, N. Y.; Harold C. Hallock, Westbury, N. Y.; Albert Hartzell, Yonkers, N. Y.; H. C. Helliwell, Shelton, Conn.; J. W. Kelley, Shelton, Conn.; Dolor LaBelle, Danielson, Conn.; C. Wm. Lacaillade, Jr., Storrs,

Conn.; J. W. Longo, Danielson, Conn.; J. A. Manter, Storrs, Conn.; J. A. McEvoy, Putnam, Conn.; B. W. McFarland, New Haven, Conn.; H. L. McIntyre, Albany, N. Y.; Saul Phillips, Albany, N. Y.; F. C. Rich, Ansonia, Conn.; John O. Schread, Storrs, Conn.; A. F. Schulze, Storrs, Conn.; R. W. Sherman, Camden, N. J.; Wm. L. Slate, New Haven, Conn.; M. D. Smith, Darien, Conn.; R. A. Spencer, Bloomfield, Conn.; O. W. Spicer, Stamford, Conn.; A. E. Stene, Kingston, R. I.; J. F. Townsend, New Haven, Conn.; Neely Turner, New Haven, Conn.; B. H. Walden, New Haven, Conn.; T. R. Ward, New London, Conn.; M. P. Zappe, New Haven, Conn.

INSPECTION OF NURSERIES IN 1928

By W. E. Britton and M. P. Zappe

The regular annual inspection of nurseries was commenced July 2, and completed October 1, except for a few nurseries registering late in the season. The work was in charge of Mr. Zappe who was assisted by Messrs. J. L. Rogers, J. F. Townsend, H. B. Bender and A. F. Clark. In a few cases assistance was rendered by E. M. Stoddard, B. H. Walden and W. E. Britton.

Mr. Bender is a botanist who was employed on this work for three months in order to pay special attention to such plant diseases as might be present in the nurseries.

In addition to the examination of the nurseries by the regular nursery inspectors, the gipsy moth scouts were instructed to make extra careful searches for gipsy moth eggs in and around all nurseries within the infested area, and to report immediately to the office in case any were discovered in or near any nursery in 1928. Also, the pine blister rust scouts under Mr. J. E. Riley, examined all nurseries where the blister rust was reported by the nursery inspectors.

On the whole, the nurseries were as well cared for and in as good condition as usual. On account of the abundant rain, leaf spots and other plant diseases were perhaps more in evidence than in some seasons—especially dry seasons. More attention was also given to recording them. On the other hand, aphids were much less prevalent than in 1927. The spruce gall aphids, *Adelges abietis* and *Gillettea cooleyi* are not greatly affected by seasonal or climatic conditions and were present in about the usual numbers; though our records show that each was found in more nurseries than last year; the increase is partly due to the increase in the number of nurseries (37 more than last year). Some nurserymen must make greater efforts to control these pests. Spraying in March or the first half of April, with a contact spray seems to be the best treatment. For this purpose, one may apply either a miscible oil (1-25), or nicotine solution and soap (1-400) equivalent to two teaspoons in a gallon of water with an inch cube of laundry soap dissolved and added as a spreader.

In 18 nurseries no important pests were found. Following is a list of insects and plant diseases found in nurseries during the annual inspection of 1928, together with the number of nurseries infested by each:

Pests Found in Nurseries in 1928

Number of Nurseries Uninfested	18

INSECTS

Name	No. Nurseries
Anisota stigma	1
Aphids, apple, green	40
woolly	60
on birch	1
boxwood	2
cherry	1
Crataegus	1
Cytisus	1
elm	8
fir	1
Heliopsis	1
mountain ash	4
pear	1
phlox	1
pine	4
red pine	1
plum	1
poplar	1
quince	3
rose	1
spirea	4
spruce	1
willow	6
spruce gall aphid	
Adelges abietis	75
Gillettea cooleyi	45
woolly, on pine bark	23
woolly, on beech	1
Apple and thorn skeletonizer	49
Arctiid larvae	1
Birch bucculatrix	1
Borer, ash	1
bronze birch	2
elm	1
Helenium	1
Iris	3
Iris (seed pod)	1
lilac	1
lilac (terminals)	1
mountain ash (terminals)	1
peach	2
poplar (Agrilus)	1
poplar	3
willow	3
Bugs on ash (Capsids)	3
Currant worm imported	3
Cutworms on rhododendron	1
Elm case bearer	7
Elm leaf beetle	3
Epitrix cucumeris	1
European pine shoot moth	7
Fall webworm	22
Four lined plant bug	1

Name	No. Nurseries
Janus abbreviatus	5
Juniper webworm	5
Lace bugs on Azalea	1
Kalmia	1
Rhododendron	48
Leafhoppers on apple	72
cherry	2
maple	1
Japanese maple	1
mountain ash	1
oak	1
pear	2
poplar	1
quince	1
rose	11
Leaf-miner in apple	2
arborvitae	7
beech	1
birch (*Fenusa pumila*)	58
boxwood	5
Catalpa bungei	19
columbine	2
locust	3
tulip tree	1
peach	1
sour gum	1
Leaf roller, privet	2
Mealy bugs, Catalpa	1
Midge on silver maple	11
Mites, European red	15
pear leaf blister	47
spruce	27
on arborvitae	1
birch	1
boxelder	2
fir	1
maple	8
oak	3
phlox	1
willow	5
Mites, galls on buttonbush	1
Oriental peach moth	26
Ormenis pruinosa	1
Otiorhynchus ovatus on arborvitae	1
Otiorhynchus sulcatus on Taxus	2
Pear psylla	23
Pear slug	27
Pistol case bearer	1
Poplar leaf beetle, *Lina scripta*.	2
Psylla on boxwood	3
Red-humped caterpillar	4

Name	No. Nurseries
Sawfly imported pine *Diprion simile*	4
on pine	2
arborvitae	3
dogwood	4
Scale, elm	6
elm scurfy	1
Euonymus	1
juniper	1
Lecanium on currant	1
oak gall	2
oyster shell	57
pine leaf	13
rose	6
San José	30
scurfy	5
tulip tree	1
West Indian Peach	2
Scale, on dogwood	1
Photinia villosa	1
Spiny elm caterpillars	1
Spittle bugs on arborvitae	3
birch	1
juniper	3
linden	1
pine	2
Tarnished plant bug	4
Tulip tree leaf gall	3
Tussock moth larvae	1
Tussock moth eggs	1
White pine weevil	19
Willow curculio	5
Willow leaf beetle imported *Plagiodera versicolora*	27
Yellow-necked caterpillars	5

Plant Diseases

Name	No. Nurseries
Anthracnose cherry	15
currant	18
oak	5
peach	1
poplar	8
willow	1
Apple scab	76
Apple mosaic	18
Bacterial disease larkspur	22
Black knot	6
Black rot, apple	58
Botrytis on *Caragana*	1
paeony	7
Canker, poplar	35
sycamore	1
Crown gall	4
Exoascus on honeysuckle	2
oak	5
Exobasidium on honeysuckle	13
Fire blight	1
Gnomonia ulmi	16
Leaf blotch rose	99
Ampelopsis	9
Leaf spot on Andromeda	1
Azalea	3
barberry	10
Bechtel's crab	1
birch	1
boxelder	18
boxwood	1
Carya	1
Catalpa	74
cherry	5
Leaf spot on dogwood	4
elm	8
English ivy	7
ginkgo	1
gooseberry	1
grape	30
hemlock	3
hollyhock	11
horsechestnut	30
hydrangea	2
Iris	48
Japanese maple	32
juglans	13
Kalmia	11
larkspur	28
lilac	2
linden	2
lupine	1
Liriodendron	1
Mahonia	1
maple	50
tar spot	9
mountain ash	29
oak	4
paeony	1
peach	1
philadelphus	1
phlox	46
Prunus pissardi	1
quince	15
raspberry	3
red bud	1
rhododendron	56

Name	No. Nurseries
Leaf spot on rhubarb	15
strawberry	26
Viburnum	3
Weigelia	1
Yucca	1
Mildew on apple	26
azalea	2
Catalpa	53
cherry	3
chrysanthemum	1
flowering crab apple	1
flowering grape	53
flowering honeysuckle	1
flowering lilac	63
flowering oak	1
flowering peach	1
pear	1
phlox	55
Platanus	1
raspberry	1
rose	49
Mildew on Symphoricarpus	1
Phomopsis juniperi	2
Raspberry cane blight	3
mosaic	12
Rust on Amelanchier	1
apple	68
ash	3
Bechtel's crab	34
Crataegus	18
hollyhock	4
juniper	8
oak	1
pear	5
pine (3 needled)	1
pine needles	2
quince	15
Scab, pear	4
White pine blister rust on pine	3
Ribes	5
Yellowing of lilacs	10

An examination of the preceding list will show that among the insects the spruce gall aphid, *Adelges abietis* as was the case last year was found in more nurseries (75) than any other insect, followed by apple leafhoppers (72), apple woolly aphid (60), birch leaf-miner, *Fenusa pumila* (58), oyster-shell scale (57), apple and thorn skeletonizer (49), rhododendron lace bug (48), pear leaf blister mite (47), apple green aphid (40), San José scale (30), spruce mite (27), imported willow leaf beetle (27), pear slug (27), Oriental fruit moth (26), pear psylla (23), pine bark aphid (23), fall webworm (22), catalpa leaf-miner (19), white pine weevil (19), European red mite (15), and pine leaf scale (13), leafhoppers on rose (11), gall midge on silver maple (11).

Among the plant diseases found in nurseries in 1928, leaf blotch of rose headed the list (99), followed by apple scab (76), leaf spot of catalpa (74), apple rust (68), mildew of lilac (63), black rot of apple (58), leaf spot of rhododendron (56), mildew of phlox (55), mildew of catalpa (53), mildew of grape (53), leaf spot of maple (50), mildew of rose (49), leaf spot of iris (48), leaf spot of phlox (46), poplar canker (35), rust on Bechtel's crab (34), leaf spot on Japanese maple (32), leaf spot on horse chestnut (30), leaf spot on grape (30), leaf spot on mountain ash (29), leaf spot on larkspur (28), leaf spot on strawberry (26), mildew on apple (26), bacterial disease of larkspur (22), currant anthracnose (18), apple mosaic (18), leaf spot on box-elder (18), rust on crataegus (18), *Gnomonia ulmi* on elm (16), cherry anthracnose (15), leaf spot on quince (15), leaf spot on

rhubarb (15), rust on quince (15), leafspot on juglans (13), Exobasidium on honeysuckle (13), raspberry mosaic (12), leaf spot on hollyhock 11, leaf spot on kalmia (11), leaf spot on barberry (10),

As has already been stated, mildews, leaf spots and other plant diseases were favored by the frequent rains, and were probably more abundant than in most seasons.

In order to show the prevalence of certain pests in nurseries in 1928, as compared with 1927, and preceding seasons, a record of them for the past eight years is given in the following table:

EIGHT-YEAR RECORD OF CERTAIN NURSERY PESTS

	1921	1922	1923	1924	1925	1926	1927	1928
Oyster-shell scale	36	44	42	44	38	39	45	57
San José scale	28	19	20	32	32	19	16	30
Spruce gall aphids*	31	21	28	40	27	42	82	120
White pine weevil	1	19	17	5	5	8	17	19
Apple and thorn skeletonizer		1	18	2	8	9	22	49
Poplar canker	21	31	34	25	34	32	39	35
Pine blister rust (on *Ribes*)	2	9	6	8	7	9	9	5
Nurseries uninfested	36	36	32	33	34	46	37	18
Number of nurseries	94	101	106	116	151	162	191	228

It should be understood that the figures in the preceding table are not strictly comparable because of the greater number of nurseries since the new law went into effect in 1925. Thus though the number of infested nurseries is greater, the actual percentage may be considerably less.

NUMBER AND SIZE OF NURSERIES

The number of nurseries in Connecticut has increased each year. The list for 1927 contained 191 names. The list for 1928 contains 228 names. Of the 228 separate nurseries in the State, a classification on account of size may be made as follows:

Nurseries containing 50 acres or more	14
" " between 10 and 50 acres	29
" " " 5 and 10 "	27
" " " 2 and 5 "	58
" " 1 acre or less	100
	228

During the year 1928, 245 nursery inspections were made The list of nursery firms receiving certificates contains 228 names; nine being new nurseries registered during the winter, and were inspected twice, once in the spring and again in the

*Includes both *Adelges abietis* and *Gillettea cooleyi*.

fall. Seven nurseries which were inspected failed to qualify in time to receive certificates during the year.

The owners of two small nurseries failing to register before July 1, as provided in Section 2, Chapter 265, Public Acts of 1925, a minimum charge of five dollars each was collected and the total amount ($10.00) was sent to the State Treasurer on January 14, 1929. The cost of inspection would have been greater had it been necessary to make a special trip from New Haven to inspect each nursery instead of making the inspection when working in the vicinity. The total area of Connecticut nurseries in 1928 is about 3,194 acres. The figures were taken from the owner's estimates indicated on the registration cards, except in cases where the acreage was not given on the cards, it was estimated by the inspector. Each nursery of less than an acre in extent is listed as one acre, and where fractions are given, the next whole number is recorded. The list of nursery firms receiving certificates in 1928 is as follows:

NURSERY FIRMS IN CONNECTICUT RECEIVING CERTIFICATES IN 1928

Name of Firm	Address	Acreage	Certificate Issued	No. of Certificate
Alius, Adolf	Stamford	1	Dec. 3	760
Allen, Henry L	North Stonington	1	Aug. 21	598
Amelunxen & DeWyn	Yalesville	3	July 26	549
Anderson, E. H	Bloomfield	3	Dec. 31	773
Austin, M. E. (2)	Clinton	1	Sept. 5	638
Barnes Bros. Nursery Co	Yalesville	160	July 26	547
Barnes Eastern Nursery	Wallingford	15	Sept. 17	669
Barnes Nursery & Orchard Co	Wallingford	75	Oct. 11	727
Barton, Robert	Hamden	1	Sept. 5	644
Beattie, W. H	New Haven	1	Aug. 28	618
Beerbaum, Wm. F	Waterbury	3	Oct. 9	725
Benbow, A	Norfolk	1	Oct. 2	708
Bertana, Louis	Glenbrook	2	Aug. 2	563
Bertolf Bros., Inc	Greenwich	45	Aug. 2	564
Birchell, George A	Stonington	2	Dec. 26	772
Booy, H. W	Yalesville	3	July 26	550
Botsford, R. C	East Haven	1	Sept. 27	698
Brainard Nursery & Seed Co.	Thompsonville	15	Sept. 4	634
Braley & Co., S. A	Burnside	4	Aug. 16	582
Branford Nurseries	Branford	4	Sept. 12	662
Bretschneider, A	Danielson	1	Sept. 19	674
Bridgeport Hydraulic Co	Bridgeport	200	Oct. 19	735
Brimfield Gardens Nursery	Wethersfield	2	Sept. 22	684
Bristol Nurseries, Inc	Bristol	40	Sept. 5	636
Brooklawn Conservatories	Bridgeport	1	Oct. 5	719
Brooklawn Nursery (2)	Fairfield	2	Oct. 14	718
Brouwer and Hancock	New London	13	Aug. 15	600
Brown, Edgar M	Hartford	1	Sept. 12	664
Bubenicek, Joseph (2)	Woodmont	1	Oct. 1	706
Buckley, Walter E	Groton	1	Aug. 17	586
Bulpitt, Henry F	Darien	5	Sept. 4	635
Bunting's Nurseries, Inc	Groton	5	Aug. 23	609

Name of Firm	Address	Acreage	Certificate Issued	No. of Certificate
Burke, P. J	Rockville	1	Aug. 6	570
Burr, Morris L	Westport	1	Aug. 30	625
Burr & Co., Inc., C. R	Manchester	500	Aug. 13	580
Burroughs, Thomas E	Deep River	4	Aug. 8	576
Burwell, E. E	New Haven	1	Oct. 11	728
Byram Evergreen Nursery	Greenwich	1	Aug. 8	579
Candee, Hollis S	Wethersfield	6	Oct. 11	726
Cant, Alexander	Springdale	1	Aug. 21	601
Cardarelli, E. J	Cromwell	2	Sept. 5	637
Case, Louis L	Simsbury	1	Sept. 25	691
Chapman, C. B	Groton	1	Aug. 28	619
Chippendale Nurseries	Old Lyme	4	Sept. 25	690
Clark, Raymond H	Milford	1	Dec. 26	771
Clinton Nurseries	Clinton	10	Nov. 8	742
Clyne, George A	Middlebury	7	Oct. 25	736
Conine Nursery Co	Stratford	50	Aug. 2	562
Conn. Agr. College (Prof. S. P. Hollister)	Storrs	1	Dec. 20	765
Conn. Agr. Expt. Station (W. O. Filley, Forester)	New Haven	2	Dec. 10	763
Conn. Valley Nurseries	Manchester	10	Aug. 6	567
Corrigan, James J	West Haven	1	Sept. 5	640
Cragholme Nurseries	Greenwich	8	July 28	558
Cromie, G. A	New Haven	1	Oct. 26	738
Dallas, Inc., Alexander	Waterbury	3	Sept. 17	671
Darien Nursery	Darien	2	Aug. 16	584
Dawson, William A	Willimantic	2	Aug. 22	607
Dunlap, Daniel S	Cromwell	3	Aug. 22	606
Dunn, James F	Stamford	2	Aug. 8	578
Dougherty, James	Yalesville	1	Aug. 21	602
Eager, Edward M	Bridgeport	1	Aug. 31	630
East Rock Park Nursery	New Haven	1	Sept. 28	705
Eells and Sons	Manchester	1	Aug. 6	574
Elfgren and Sons, I. P	East Killingly	1	Aug. 17	589
Elm City Nursery Co. (Woodmont Nurseries, Inc.)	Woodmont	120	Sept. 4	633
Elm Grove Cemetery Assoc.	Mystic	1	Oct. 8	720
Ensign-Bickford Co. (S. W. Eddy, Supt.)	Avon	5	Nov. 26	751
Evergreen Nursery Co	Wilton	15	July 28	557
Fairty, C. H	New Canaan	2	Aug. 16	585
Farmington Valley Nursery (Harry D. Wilcox, Prop.)	Avon	2	Sept. 28	702
Flower City Rose Co	Manchester	20	Aug. 6	569
Fraser's Nurseries & Dahlia Gardens	Willimantic	3	Oct. 2	714
Gardner's Nurseries	Rocky Hill	75	Sept. 11	659
Geduldig's Greenhouses	Norwich	8	Aug. 29	623
Giandomenico, R. Di	Middletown	1	July 26	553
Gilbert and Bruce	Killingly	1	Aug. 17	587
Giuliano, J. S	Wethersfield	1	Sept. 25	692
Glen Terrace Nurseries (Jas. H. Everett, Prop.)	Mount Carmel	25	Dec. 3	761
Golden Hill Nursery (Andrew Johnson, Prop.)	Shelton	2	Nov. 15	745
Goodwin Nurseries	Bloomfield	7	Oct. 8	722
Grillo, N	Milldale	1	Aug. 29	624

Name of Firm	Address	Acreage	Certificate Issued	No. of Certificate
Hamden Nursery (John Carolla, Prop.)	Hamden	1	Oct. 9	723
Hansen, Peter	Fairfield	7	Sept. 18	673
Hawes, Frank M	West Hartford	1	Sept. 12	663
Hearn, Thomas H	Washington	2	Aug. 25	612
Heath and Co	Manchester	7	Aug. 6	568
Henninger, Christ	New Britain	1	Sept. 24	689
Hilliard, H. J	Sound View	1	Sept. 22	686
Hiti Nurseries	Pomfret Center	8	Aug. 23	608
Holcomb, H. Parks	Winsted	1	Nov. 27	754
Holcomb, Irving	Granby	1	Aug. 6	575
Holdridge, S. E	Ledyard	3	Aug. 21	597
Horan, James F	Hartford	3	Dec. 1	759
Horan and Son, James	Bridgeport	1	Nov. 26	749
Houston, Byron D	Mansfield	15	Oct. 16	732
Hoyt, Chas. E. (2)	Danbury	2	Sept. 5	642
Hoyt's Sons Co., Inc., Stephen	New Canaan	500	Aug. 3	565
Hull, Curtis M	Wallingford	3	Sept. 27	696
Hunt and Co., W. W	Hartford	8	Sept. 10	656
Huntoon, Gerald W	Rocky Hill	1	Sept. 12	665
Innes, William	Milford	2	Nov. 15	744
Intravaia, Joseph	Middletown	1	July 26	554
Jankovich, Joseph	Plantsville	1	Sept. 7	650
Jennings, G. S	Southport	1	Aug. 28	621
Joel Nursery Co	Wallingford	5	Nov. 27	755
Johnson, Tom	Stratford	1	Aug. 31	629
Judd, T. H	Danbury	1	Dec. 13	764
Kauser, Alice	Norwalk	1	July 28	560
Kelley & Son, James J	Darien	5	Sept. 10	653
Kennedy, Mary H. (2)	East Hartford	1	Aug. 6	571
Kerner, Eugene	Woodbury	1	Dec. 22	768
Keystone Nurseries (H. H. Kellner, Prop.)	Danbury	1	Sept. 5	643
Langstroth Conifer Nursery	Danbury	4	Aug. 3	626
Leghorn, John J	Cromwell	10	Aug. 22	605
Lewis & Valentine, Inc	Darien	11	Aug. 18	591
Liljenstein, Carl	New London	1	Aug. 17	588
Lundberg, E. A	Darien	1	Aug. 8	577
MacKeever, Frank C	Rowayton	1	Aug. 28	620
Malavasi, Sam	Woodbridge	3	Oct. 3	717
Mallett, George A	Bridgeport	5	Sept. 20	681
Maplewood Nursery Co. (F. M. Oat, Mgr.)	Norwich	3	Dec. 24	770
Marigold Farm (Henry Kelley, Prop.)	New Canaan	10	Sept. 13	667
Mars, F. H. De (2)	Winsted	1	Oct. 2	709
Mason, Warren S	Farmington	1	Sept. 5	645
Mayapple Nurseries (Paul M. Barrows, Prop.)	Stamford	1	Aug. 24	611
Maynard and Gadbois	Old Lyme	1	Dec. 21	766
McConville, John	Manchester	1	Aug. 6	575
Meachen, George C	Stratford	1	Oct. 1	707
Meier, A. R	West Hartford	1	Nov. 28	757
Merwin Lane Nursery	Greenfield Hill	6	Sept. 12	661
Meyer, Ludwig	Bridgeport	1	Sept. 28	704
Middeleer, Inc	Darien	20	Sept. 19	675
Millane Nurseries	Cromwell	20	Sept. 27	695

Name of Firm	Address	Acreage	Certificate Issued	No. of Certificate
Minge, C. H	Rocky Hill	1	Oct. 9	724
Moraio Bros	Stamford	5	Aug. 29	622
Moulthrop, William	Watertown	3	Sept. 7	651
Mount Airy Gardens (R. L. Wilson, Prop.)	North Stamford	1	July 28	561
Mount Carmel Nursery	Mount Carmel	1	Sept. 27	697
New Britain Board of Water Commissioners	New Britain	50	Sept. 24	688
New Haven Nurseries (L. A. Soldan, Mgr.)	New Haven	1	Oct. 31	741
New Haven Park Commission (G. X. Amrhyn, Supt.)	New Haven	20	Sept. 17	670
New London Cemetery Association	New London	1	Oct. 17	734
New London County Nurseries	New London	8	Oct. 3	716
New York, New Haven and Hartford Railroad Co. (C. H. Haggerty)	Stamford	5	Oct. 3	715
Nicholson & Thurston	Litchfield	1	Aug. 28	617
Northeastern Forestry Co.	Cheshire	66	July 26	546
Norwood Nursery	Hamden	1	Sept. 7	652
Oakland Nurseries	Manchester	20	Aug. 18	590
Old Orchard Nursery (R. G. Hanford, Prop.)	Norwalk	3	Nov. 26	750
Ostergren, Herbert	Cromwell	2	Aug. 22	604
Outpost Nurseries	Ridgefield	90	Sept. 10	657
Ouwerkerk, D. K	Yalesville	10	July 26	552
Park Gardens	Bridgeport	1	Sept. 24	687
Park Place Nurseries (R. E. Upson, Prop.)	Marion	5	Sept. 25	693
Patrick, Charles	Bridgeport	1	Nov. 26	752
Pedersen, Anthon	Stamford	2	Sept. 22	683
Pequod Nursery Co	Yalesville	15	July 26	548
Peschko, Robert	Danbury	1	Aug. 30	627
Phelps and V. T. Hammer Co., The J. W	Branford	3	Sept. 27	700
Phillips, Alice G	Milton	1	Oct. 2	711
Pierrepont, Seth L	Ridgefield	12	Dec. 22	769
Pierson, Inc., A. N	Cromwell	150	Aug. 24	610
Pinatello, Michael	East Hartford	2	Nov. 26	748
Pinchbeck Bros., Inc	Ridgefield	3	Sept. 17	668
Polish Orphanage Farm	New Britain	1	Oct. 29	739
Pomeroy Blue Spruce Gardens	New Milford	5	Aug. 25	613
Prospect Nurseries (S. C. Hubbard, Prop.)	Cromwell	5	Sept. 6	646
Prudence Seymour Gardens (Mary T. Parfitt, Prop.)	New Milford	1	Aug. 28	614
Rabinak, Louis	Deep River	1	Oct. 8	721
Rengerman, A. B	Granby	1	Sept. 10	655
Reynolds, Stephen	South Norwalk	1	July 27	556
Richmond, Gordon L	New Milford	1	Aug. 28	615
Rockfall Nursery Co	Rockfall	80	Sept. 6	648
Rottenberg, Julius	Newington	1	Sept. 28	703
Russell, C. B	Newington	1	Sept. 19	678
Sage, Hollister	Woodbury	1	Sept. 7	649
Sargeant, Mrs. A. R	Tolland	1	Aug. 6	566

Name of Firm	Address	Acreage	Certificate Issued	No. of Certificate
Saxe-Floto	Waterbury	1	Oct. 31	740
Schaeffer Bros	Ledyard	3	Aug. 21	596
Scheepers, Inc., John	Stamford	10	July 26	555
Schulze, Charles T	Bethel	2	Nov. 27	753
Scott's Nurseries	Bloomfield	4	Nov. 27	756
Seltsam, George	Bridgeport	1	Sept. 19	680
Seymour, Fred R	Riverton	2	Oct. 2	710
Shailer, Edwin E. (2)	Haddam	1	July 28	559
Shelton, Philo S	Fairfield	4	Sept. 19	677
Sierman, C. H	Hartford	8	Oct. 2	713
Simonsen, H. C	Plainville	3	Dec. 10	762
Snelgrove, S. J	Windsor	2	Aug. 31	632
Soltes, Martin	Shelton	1	Nov. 13	743
Southport Nursery (Coari & Sons, Props.)	Southport	20	Sept. 12	666
South Wilton Nurseries (J. C. Van Heiningen, Prop.)	South Wilton	4	Aug. 14	581
Spencer, W. L. L. (2)	Columbia	1	Aug. 22	603
Spring Nurseries (H. C. Barnes, Prop.)	Bristol	2	Sept. 5	639
State of Connecticut (A. F. Hawes, State Forester)	Simsbury	5	Sept. 10	654
State Street Nursery (John Natyzon, Prop.)	New Haven	2	Sept. 12	660
Steck, Charles A	Newtown	8	Sept. 6	647
Steck, Jr., Charles A	Bethel	2	Oct. 15	730
Steck, Harold W	Farmington	10	Oct. 11	729
Steck, Sarah B	Bethel	1	Sept. 10	658
Stratfield Nurseries (Geo. R. Godfrey, Prop.)	Bridgeport	35	Oct. 17	733
Stratford Rose Nurseries (John Barrows, Prop.)	Stratford	1	Aug. 31	631
Szirbik & Co., George	New Haven	1	Sept. 18	672
Tanner, E. G	Manchester	1	Aug. 6	573
Thomas Nursery	Hamden	2	Dec. 22	767
Tryon, George W	North Stonington	1	Aug. 21	599
Van Der Bom Nursery	Bethel	1	Aug. 30	628
Vanderbrook & Son, Charles L	Manchester	21	Aug. 20	592
Vanderstam, C. L	Yalesville	2	July 26	551
Van Wilgen Nurseries	Branford	8	Nov. 23	746
Vasileff, Nicholas	Greenwich	2	Sept. 22	682
Verkades' Nurseries	New London	37	Aug. 20	593
Vernik, John	Fairfield	2	Nov. 26	747
Wallace, A. T	Wallingford	7	Sept. 27	699
Wayside Farm Gardens (Miss I. E. Aldrich, Prop.)	Thomaston	2	Aug. 28	616
Wegner, C. F	Noroton Heights	3	Nov. 28	758
Weirether, Leo (2)	West Haven	1	Sept. 22	685
Wheeler, C. B	North Stonington	1	Aug. 21	595
Wild, Henry	Greenwich and Norwalk	30	Sept. 27	694
Williams, Carl C	Southport	1	Oct. 15	731
Williams, Harry G	Shelton	1	Sept. 19	676
Wilcox, Elmer E	Guilford	1	Aug. 21	594
Wilson & Co., C. E	Manchester	110	Aug. 16	583
Woodruff, Carleton V	Orange	1	Oct. 2	712

Name of Firm	Address	Acreage	Certificates Issued	No. of Certificate
Wyllie, David	Whitneyville	1	Sept. 5	641
Yale Landscape Department	New Haven	2	Oct. 26	737
Yale School of Forestry	New Haven	2	Sept. 19	679
Zack Co., H. J	Deep River	12	Sept. 27	701
Total acres		3,194		

Inspection of Raspberry Plantations

Each year for several years, certain nurserymen and raspberry growers have applied for special inspections and certificates in order to permit them to sell plants, free from the so-called mosaic diseases. Without these special certificates they are unable to ship raspberry plants into the five states of Michigan, Minnesota, New York, Vermont and Wisconsin. In 1928, two nursery firms duly applied for the special inspection and certificates. The inspections were made at the proper time and the diseased plants removed. After the second inspection two certificates were granted. Certain varieties contained too much mosaic to be covered by the certificates, which include only the varieties indicated as follows:

Special Certificates on Raspberry Plants

Name of Firm	Address	Variety	Certificate Date of Issue	Certificate Number
Barnes Nursery & Orchard Co.	Wallingford	Latham	Oct. 18	18
Conine Nursery Co	Stratford	Cuthbert La France St. Regis White Queen	Oct. 17	17

Nursery Dealers

Chapter 265, Public Acts of 1925, provides that dealers in nursery stock must register each year, on or before March 1, with the State Entomologist, and cite the principal sources of their nursery stock. All dealers' permits are for the remainder of the calendar year and expire on December 31. During the year 104 such dealers have registered and received permits. The list of dealers is on file in the office of the State Entomologist but is not printed in this Report.

Out-of-State Nurserymen

Nurserymen in other states wishing to ship stock into Connecticut are required to file with the State Entomologist signed copies of their nursery inspection certificates and make application for

permits to ship stock into the State. These permits are valid only for the periods covered by the certificates placed on file. During the year 261 permits have been issued to nurserymen in other states, but the list of firms receiving them is not printed in this Report.

Parcel Certificates

In addition to the regular inspection and certification of nursery stock, occasionally individuals wish to send shrubs and plants to their friends, and sometimes nurserymen need to ship packages before receiving their regular certificates. Consequently 237 separate parcels of nursery stock have been inspected and package certificates furnished.

Inspection of Narcissus Bulbs

On account of Federal quarantine No. 62, narcissus bulbs grown in Connecticut cannot be shipped into other states unless given two inspections, one in the field in May, and the other after the bulbs have been dug for shipment. In case they are found to be infested with bulb flies or eelworms, they must then be treated. During the year 45,500 such bulbs were inspected and certified.

Inspecton of Laurel and Decorative Materials

Considerable decorative material is gathered each year in Connecticut woodlands and shipped into New York City. This is mostly mountain laurel, *Kalmia latifolia*. If gathered within the gipsy moth quarantined area, it is examined by Federal inspectors, and if found clean, is certified for shipment. Much of it is collected outside the quarantined area and yet cannot enter New York without being certified. During the year 151 such certificates were issued.

Inspection of Shelled Seed Corn

On account of the European corn borer having been found in a small portion of Connecticut, certain states would not allow shelled sweet corn for seed to enter unless it had been inspected and certified to be free from bits of cob large enough to carry borers. Therefore a large quantity of such seed corn was inspected as it came through the cleaning mill, and 475 certificate tags were issued.

INSPECTION OF IMPORTED NURSERY STOCK

W. E. Britton and M. P. Zappe

Beginning with the year 1920, only rose and fruit tree seedlings have been allowed to enter Connecticut from foreign countries. All other nursery stock is prohibited, except new varieties for propagation which must enter through Washington, D. C., where the material is inspected and if infested, treated and held under quarantine or destroyed. Even the rose and fruit seedlings enter the country under regulations prescribed by the Federal Horticultural Board, now called the Plant Quarantine and Control Administration. The system requires applications, permits, proper marking, releases at ports of entry, inspection at points of destination and reports of the inspection sent to Washington. The ispection is usually made by the State officers. The imported nursery stock entering Connecticut in 1928 has been inspected by Mr. Zappe with the assistance at rush periods of Messrs. B. H. Walden, B. W. McFarland and R. C. Botsford. In number of shipments, number of cases and number of plants, the importations of 1928 were somewhat less than those of the preceding four years, as the following table shows:

Year	No. of shipments	No. of cases	No. of plants
1920	17	87	814,491
1921	21	126	1,228,560
1922	30	159	1,997,595
1923	35	179	1,981,895
1924	33	313	3,489,170
1925	27	277	2,977,346
1926	32	347	3,443,357
1927	31	321	3,229,915
1928	36	277	2,680,700

Sources of Imported Nursery Stock, 1927-1928

As in preceding years the greatest number of shipments came from Holland, but from France came the greatest number of cases and plants. The record for the year is as follows:

Country	No. of shipments	No. of cases	No. of plants
Holland	13	132	1,019,500
France	10	142	1,643,200
England	3	3	18,000
Total	26	277	2,680,700

These 26 shipments were imported by nine different firms of Connecticut nurserymen and florists, 15 shipments being con-

signed to two firms. Nine shipments were composed of fruit stock and 17 shipments of rose stock.

Kinds of Stock Imported

Of this plant material inspected, 1,273,500, or about 48 per cent were rose plants, and 1,407,200, or nearly 52 per cent were fruit tree seedlings. The number of each kind is shown in the following table:

FRUIT STOCKS

Variety	No. of plants	Total
Apple (all kinds)	486,000	
Cherry (all kinds)	671,700	
Pear	134,500	
Plum	105,000	
Quince	10,000	1,407,200

ROSE STOCKS

Variety	No. of plants	Total
Manetti rose	1,109,500	
Multiflora rose	42,000	
Rugosa rose	122,000	1,273,500
Grand total fruit stocks and rose stocks		2,680,700

The following table shows the quantities of stock inspected by months:

Month	No. of shipments	No. of cases	No. of plants
December	6	28	253,000
January	9	145	1,626,200
February	6	27	262,000
March	3	34	315,500
April	2	43	224,000
Total	26	277	2,680,700

The time required to inspect this imported plant material is equivalent to one man working 27 days and his time, traveling and other necessary expenses amounts to about $400.00.

In addition to the inspected material enumerated and tabulated above, there were 37 shipments of tree seeds which were not inspected in Connecticut, but which were fumigated at the port of entry. Of all shipments of imported stock 26 reports were made to the Federal Horticultural Board at Washington. There were also 11 shipments of new varieties for propagation, which were inspected at Washington, D. C.

Of the 26 shipments inspected, 15 shipments or about 58 per cent were found infested with insects, some of which are well-known pests. Detailed information regarding them follows:

PESTS FOUND ON IMPORTED NURSERY STOCK

15 Shipments Infested

Acronycta auricoma Schiff. (2 shipments). On quince, pear and plum, A. Fermaud, Angers, France; on apple and cherry, Andre Choplin, Maze, France.

Aporia crataegi Linn. (1 shipment). On apple, 5 nests, A. Fermaud, Angers, France.

Blaps mucronata Latr. (1 shipment). On cherry, A. Fermaud, Angers, France.

Emphytus cinctus Linn. (9 shipments). On manetti rose, Association Flora, C. Klyn & Co., Otto & Sons, Boskoop, H. H. Woldering, Veendam, Holland; Andre Choplin, Maze, France; Geo. I. Adamds, Tunbridge Wells, W. C. Slocock, Surrey, England.

Lampyrid eggs (1 shipment). In gallery of *Emphytus cinctus* in manetti rose, Geo. I. Adamds, Tunbridge Wells, England.

Lepidopterous pupae (2 shipments). Dead crushed specimens on cherry, Andre Choplin, Maze, France; Hemeray-Aubert, Orleans, France.

Mamestra dissimilis Kn. (1 shipment). Cocoon on rose, Andre Choplin, Maze, France.

Notolophus antiqua Linn. (5 shipments). One egg-mass on apple, 1 on rose, Andre Choplin, Maze, France; 3 egg-masses on apple, A. Fermaud, Angers, France; 1 egg-mass on apple, V. Lebreton, La Pyramide, France.

Papilio podalirius Linn. (1 shipment). On cherry, Andre Choplin, Maze, France.

Paratetranychus pilosus C. and F. (1 shipment). On apple, V. Lebreton, La Pyramide, France.

Woolly aphid (3 shipments). On apple, A. Fermaud, Angers, France, V. Lebreton, La Pyramide, France.

INSPECTION OF APIARIES IN 1928

In 1928, as in preceding years, the apiaries, of Connecticut have been inspected by Messrs. H. W. Coley, of Westport, and A. W. Yates, of Hartford, who have worked on a *per diem* basis. Mr. Coley has covered the southern half of the State, (Fairfield, New Haven, Middlesex and New London Counties), and Mr. Yates the northern half (Litchfield, Hartford, Tolland, and Windham Counties).

This inspection work in 1928 required 138 man days and together with traveling expenses cost $1,805.05. In all, 852 apiaries, containing 8,023 colonies, were inspected in 1928 as against 803 apiaries containing 8,133 colonies in 1927. The apiaries averaged 9.41 colonies each in 1928 and 10.1 each in 1927.

The following table shows the number of apiaries and colonies inspected and the average number of colonies per apiary, as well as the cost per apiary and colony for each year since the inspection work originated in 1910:

NINETEEN YEAR RECORD OF APIARY INSPECTION IN CONNECTICUT

Year	No. of Apiaries	No. of Colonies	Average No. Colonies Per Apiary	Average Cost of Inspection Per Apiary	Average Cost of Inspection Per Colony
1910	208	1,595	7.6	$2.40	.28
1911	162	1,571	9.7	1.99	.21
1912	153	1,431	9.3	1.96	.21
1913	189	1,500	7.9	1.63	.21
1914	463	3,882	8.38	1.62	.19
1915	494	4,241	8.58	1.51	.175
1916	467	3,898	8.34	1.61	.19
1917	473	4,506	9.52	1.58	.166
1918	395	3,047	7.8	1.97	.25
1919	723	6,070	11.2	2.45	.29
1920	762	4,797	6.5	2.565	.41
1921	751	6,972	9.2	2.638	.24
1922	797	8,007	10.04	2.60	.257
1923	725	6,802	9.38	2.55	.27
1924	953	8,929	9.4	2.42	.25
1925	766	8,257	10.7	2.45	.22
1926	814	7,923	9.7	2.35	.24
1927	803	8,133	10.1	2.37	.234
1928	852	8,023	9.41	2.12	.225

In 1928, apiaries were inspected in 149 towns as against 135 towns in 1927, and 137 towns in 1926.

Inspections were made in the following towns in 1928 which were not visited in 1927: Fairfield County—New Fairfield, Sherman; New Haven County—Bethany, Branford, Cheshire, East Haven, Hamden, Meriden, Middlebury, New Haven, North Branford, Orange, Southbury, Wolcott, Woodbridge; Middlesex County—Killingworth, Saybrook; New London County—East Lyme, Old Lyme, Preston, Sprague; Litchfield County—Cornwall, Goshen; Hartford County—Enfield, Southington, South Windsor; Windham County—Pomfret, Sterling.

On the other hand, the following 15 towns, where inspections were made in 1927, were not visited by the inspectors in 1928: Fairfield County—Trumbull, Weston, Shelton, Monroe; New Haven County—Ansonia, Beacon Falls, Prospect; New London County—Lisbon; Litchfield County—Barkhamsted; Tolland County—Willington; Windham County—Ashford, Chaplin, Eastford, Hampton, Thompson.

There are several towns where no recent inspections have been made. In Warren (Litchfield County) no apiaries have been inspected since 1919, though the inspector has made inquiries and failed to learn of any beekeepers in the town. Bridgeport (Fairfield County) has not been inspected since 1926. No inspection has been made in Eastford (Windham County) since 1924.

European Foul Brood

This is a disease of the young larvae, caused by a bacterial germ known as *Bacillus pluton,* and commonly called European foul

brood. Usually it is more troublesome in early summer than at other times during the year, the cell contents are not ropy or gelatinous, and though often with the odor of fermentation, it is not very offensive. Requeening with Italian queens and uniting two or more weak colonies to make them strong are common methods of control.

Of the 852 apiaries and 8,023 colonies inspected in 1928, 9 apiaries and 26 colonies were found infested with European foul brood. This infestation amounts to 1.05 per cent of the apiaries and .324 per cent of the whole number of colonies inspected during the season.

The following table gives a complete record of percentages of infestation of European foul brood in Connecticut since the inspection work began in 1910:

RECORD OF EUROPEAN FOUL BROOD

Year	Percentage of Infestation Apiaries	Colonies	Year	Percentage of Infestation Apiaries	Colonies
1910	75.9	49.7	1919	6.6	1.2
1911	51.8	27.4	1920	4.3	1.5
1912	47.7	23.5	1921	3.91	1.26
1913	44.4	24.5	1922	4.14	.85
1914	32.6	13.9	1923	2.34	.36
1915	26.1	10.3	1924	1.78	.526
1916	18.8	7.05	1925	2.48	.507
1917	16.7	4.86	1926	3.19	.858
1918	9.8	3.3	1927	1.12	.282
			1928	1.05	.324

During 1928, European foul brood was discovered only in the following 7 towns: Old Saybrook in Middlesex County; Bristol, Marlborough, New Britain, Newington, and Wethersfield in Hartford County; Brooklyn in Windham County. No apiaries infested with this disease were found in Fairfield, New Haven, New London, Litchfield or Tolland Counties.

American Foul Brood

American foul brood is also a disease of the larvae caused by the bacterial organism known to science as *Bacillus larvae,* but it attacks the brood at a later stage of development than does the European foul brood. It usually shows when the larvae are nearly mature or pupating after the cells are sealed. The diseased cells are shrunken, and if broken open, the contents have a peculiar ropy or stringy consistency and give off a very offensive odor. Formerly the treatment was to shake the bees into clean hives, destroy the infected combs, and disinfect the old hives. Now the diseased combs may be sterilized by soaking them in an alcohol-formalin solution containing twenty per cent of formalin, after which they may be used with safety.

Of the 852 apiaries and 8,023 colonies inspected in 1928, 36 apiaries and 79 colonies were infested with American foul brood. This infestation is equivalent to 4.213 per cent of the apiaries and .98 per cent of the colonies inspected in 1928. This record for 1928 is a greater percentage of infested apiaries than is usually found. It is the highest percentage of apiaries ever found and in only one year (1919) has the percentage of colonies infested with this disease been greater in Connecticut since the inspection work started in Connecticut.

The following table shows a complete record regarding American foul brood since apiary inspection was started in Connecticut in 1910.

RECORD OF AMERICAN FOUL BROOD

Year	Percentage of Infestation Apiaries	Colonies	Year	Percentage of Infestation Apiaries	Colonies
1910	0	0	1919	3	1.1
1911	0	0	1920	1.18	.25
1912	0	0	1921	2.5	.56
1913	0	0	1922	1.38	.27
1914	1.07	.7	1923	.985	.323
1915	.8	.18	1924	1.04	.22
1916	1.07	.15	1925	3.26	.424
1917	.42	.17	1926	1.72	.29
1918	1.01	.32	1927	3.11	.70
			1928	4.213	.98

During 1928, American foul brood was found in the following 22 towns: Ridgefield and Wilton in Fairfield County; Branford, Cheshire, Hamden, Prospect, and Wallingford in New Haven County; Chester and Middlefield in Middlesex County; East Lyme in New London County; Bethlehem, Thomaston, Watertown and Winchester in Litchfield County; Bristol, Hartland, Manchester, West Hartford and Windsor in Hartford County; Andover and Ellington in Tolland County, and Brooklyn in Windham County.

Sacbrood

Sacbrood or pickled brood is a disease often mistaken for American or European foul brood. The cause is considered to be a filterable virus. The larvae die about the time the cells are capped and lie on their backs with heads turned upward. The body is swollen and contents watery, but there is no ropiness, and the entire cell contents may easily be removed intact as if enclosed in a sac. The color is variable, though often light yellow or brown, with head nearly black. The usual treatment is to make strong colonies by uniting the weak ones. In certain rare cases where whole apiaries become infected, new queens should be supplied to all the colonies.

The following table shows the record of sacbrood since apiary inspection in Connecticut started in 1910:

RECORD OF SACBROOD

Year	Percentage of Infestation Apiaries	Colonies	Year	Percentage of Infestation Apiaries	Colonies
1910	0	0	1919	1.24	.19
1911	..	.51	1920	1.18	.229
1912	..	Several	1921	1.06	.157
1913	..	2.8	1922	1.37	.187
1914	2.59	.721	1923	.53	.086
1915	2.02	.47	1924	1.78	.52
1916	.428	.051	1925	3.39	.836
1917	1.48	.199	1926	1.1	.138
1918	.253	.032	1927	.03	.0036
			1928	.035	.087

During the year Sacbrood was found in the following 2 towns: Wallingford in New Haven County and Killingworth in Middlesex County.

Statistics of Inspection

The statistics of apiary inspection by towns and counties are given in the following pages with summary on page 711.

INSPECTION OF APIARIES, 1928

Town	Apiaries Inspected	Apiaries Diseased	Colonies Inspected	Colonies Diseased	Foul Brood American	Foul Brood European	Sacbrood
Fairfield County:							
Bethel	6	0	44	0	0	0	0
Bridgeport	0	0	0	0	0	0	0
Brookfield	3	0	62	0	0	0	0
Danbury	1	0	16	0	0	0	0
Darien	1	0	28	0	0	0	0
Easton	1	0	70	0	0	0	0
Fairfield	3	0	46	0	0	0	0
Greenwich	6	0	34	0	0	0	0
Monroe	0	0	0	0	0	0	0
New Canaan	2	0	28	0	0	0	0
New Fairfield	3	0	27	0	0	0	0
Newtown	0	0	0	0	0	0	0
Norwalk	1	0	16	0	0	0	0
Redding	2	0	40	0	0	0	0
Ridgefield	5	4	32	14	14	0	0
Shelton	0	0	0	0	0	0	0
Sherman	1	0	5	0	0	0	0
Stamford	4	0	57	0	0	0	0
Stratford	1	0	28	0	0	0	0
Trumbull	0	0	0	0	0	0	0
Weston	0	0	0	0	0	0	0
Westport	2	0	32	0	0	0	0
Wilton	12	3	147	11	11	0	0
	54	7	712	25	25	0	0

Town	Apiaries Inspected	Apiaries Diseased	Colonies Inspected	Colonies Diseased	Foul Brood American	Foul Brood European	Foul Brood Sacbrood
New Haven County:							
Ansonia	0	0	0	0	0	0	0
Beacon Falls	0	0	0	0	0	0	0
Bethany	5	0	14	0	0	0	0
Branford	2	1	14	2	2	0	0
Cheshire	6	1	108	3	3	0	0
Derby	1	0	5	0	0	0	0
East Haven	2	0	15	0	0	0	0
Guilford	8	0	44	0	0	0	0
Hamden	7	0	73	0	0	0	0
Madison	3	2	14	2	2	0	0
Meriden	4	0	56	0	0	0	0
Middlebury	4	0	30	0	0	0	0
Milford	2	0	33	0	0	0	0
Naugatuck	5	0	60	0	0	0	0
New Haven	2	0	10	0	0	0	0
North Branford	1	0	12	0	0	0	0
North Haven	1	0	26	0	0	0	0
Orange	4	0	25	0	0	0	0
Oxford	0	0	0	0	0	0	0
Prospect	4	1	34	1	1	0	0
Seymour	1	0	27	0	0	0	0
Southbury	1	0	14	0	0	0	0
Wallingford	13	3	83	9	4	0	5
Waterbury	5	0	26	0	0	0	0
West Haven	0	0	0	0	0	0	0
Wolcott	2	0	12	0	0	0	0
Woodbridge	2	0	28	0	0	0	0
	85	8	763	17	12	0	5
Middlesex County:							
Chester	8	0	50	0	0	0	0
Clinton	5	1	59	2	2	0	0
Cromwell	4	0	55	0	0	0	0
Durham	0	0	0	0	0	0	0
East Haddam	4	0	154	0	0	0	0
East Hampton	9	0	115	0	0	0	0
Essex	4	0	37	0	0	0	0
Haddam	5	0	63	0	0	0	0
Killingworth	7	1	17	2	0	0	2
Middlefield	2	1	36	8	8	0	0
Middletown	4	0	56	0	0	0	0
Old Saybrook	5	0	74	14	0	14	0
Portland	6	0	44	0	0	0	0
Saybrook	1	0	16	0	0	0	0
Westbrook	1	0	8	0	0	0	0
	65	4	784	26	10	14	2
New London County:							
Bozrah	1	0	9	0	0	0	0
Colchester	12	0	143	0	0	0	0
East Lyme	2	1	98	1	1	0	0
Franklin	2	0	89	0	0	0	0
Griswold	1	0	72	0	0	0	0
Groton	6	0	82	0	0	0	0
Lebanon	11	0	132	0	0	0	0

Town	Apiaries Inspected	Apiaries Diseased	Colonies Inspected	Colonies Diseased	Foul Brood American	Foul Brood European	Sacbrood
New London County—*cont.*							
Ledyard	5	0	61	0	0	0	0
Lisbon	0	0	0	0	0	0	0
Lyme	2	0	86	0	0	0	0
Montville	7	0	64	0	0	0	0
New London	3	0	15	0	0	0	0
North Stonington	1	0	15	0	0	0	0
Norwich	14	0	459	0	0	0	0
Old Lyme	1	0	14	0	0	0	0
Preston	4	0	95	0	0	0	0
Salem	1	0	9	0	0	0	0
Sprague	2	0	62	0	0	0	0
Stonington	5	0	68	0	0	0	0
Voluntown	2	0	12	0	0	0	0
Waterford	2	0	34	0	0	0	0
	84	1	1,619	1	1	0	0
Litchfield County:							
Barkhamsted	0	0	0	0	0	0	0
Bethlehem*	11	2	43	3	3	0	0
Bridgewater	5	0	87	0	0	0	0
Canaan	3	0	15	0	0	0	0
Colebrook	2	0	27	0	0	0	0
Cornwall	4	0	20	0	0	0	0
Goshen	4	0	35	0	0	0	0
Harwinton	7	0	17	0	0	0	0
Kent	5	0	99	0	0	0	0
Litchfield	9	0	122	0	0	0	0
Morris	5	0	27	0	0	0	0
New Hartford	9	0	29	0	0	0	0
New Milford	6	0	111	0	0	0	0
Norfolk	3	0	16	0	0	0	0
North Canaan	2	0	63	0	0	0	0
Plymouth	8	0	34	0	0	0	0
Roxbury	5	0	38	0	0	0	0
Salisbury	7	0	80	0	0	0	0
Sharon	5	0	71	0	0	0	0
Thomaston	8	2	32	3	3	0	0
Torrington	12	0	89	0	0	0	0
Warren	0	0	0	0	0	0	0
Washington	8	0	140	0	0	0	0
Watertown	11	1	53	3	3	0	0
Winchester	14	1	68	1	1	0	0
Woodbury	5	0	86	0	0	0	0
	158	6	1,402	10	10	0	0
Hartford County:							
Avon	5	0	19	0	0	0	0
Berlin	12	0	227	0	0	0	0
Bloomfield	10	0	159	0	0	0	0
Bristol*	17	2	93	3	2	1	0
Burlington	4	0	26	0	0	0	0
Canton	10	0	48	0	0	0	0
East Granby	3	0	20	0	0	0	0

*One colony inspected twice.

Town	Apiaries Inspected	Apiaries Diseased	Colonies Inspected	Colonies Diseased	Foul Brood American	Foul Brood European	Sacbrood
Hartford County—*cont.*							
East Hartford	8	0	38	0	0	0	0
East Windsor	15	0	83	0	0	0	0
Enfield	9	0	51	0	0	0	0
Farmington	12	0	75	0	0	0	0
Glastonbury	8	0	91	0	0	0	0
Granby	9	0	65	0	0	0	0
Hartford	2	0	22	0	0	0	0
Hartland	2	2	98	3	3	0	0
Manchester	11	2	63	2	2	0	0
Marlborough	2	1	29	2	0	2	0
New Britain	9	2	79	2	0	2	0
Newington†	9	1	65	4	0	4	0
Plainville	14	0	46	0	0	0	0
Rocky Hill	4	0	32	0	0	0	0
Simsbury	10	0	51	0	0	0	0
Southington	7	0	35	0	0	0	0
South Windsor	7	0	40	0	0	0	0
Suffield	12	0	76	0	0	0	0
West Hartford	15	3	96	5	5	0	0
Wethersfield	15	2	71	2	0	2	0
Windsor*	18	1	94	1	1	0	0
Windsor Locks	2	0	8	0	0	0	0
	261	16	1,900	24	13	11	0
Tolland County:							
Andover	6	1	17	7	7	0	0
Bolton	4	0	17	0	0	0	0
Columbia	7	0	27	0	0	0	0
Coventry	13	0	74	0	0	0	0
Ellington	9	1	41	1	1	0	0
Hebron	6	0	25	0	0	0	0
Mansfield	8	0	34	0	0	0	0
Somers	2	0	9	0	0	0	0
Stafford	13	0	40	0	0	0	0
Tolland	8	0	42	0	0	0	0
Union	3	0	2	0	0	0	0
Vernon	3	0	19	0	0	0	0
Willington	0	0	0	0	0	0	0
	82	2	347	8	8	0	0
Windham County:							
Ashford	0	0	0	0	0	0	0
Brooklyn	3	1	109	1	0	1	0
Canterbury	4	0	56	0	0	0	0
Chaplin	0	0	0	0	0	0	0
Eastford	0	0	0	0	0	0	0
Hampton	0	0	0	0	0	0	0
Killingly	6	0	40	0	0	0	0
Plainfield	12	0	47	0	0	0	0
Pomfret	5	0	29	0	0	0	0
Putnam	5	0	36	0	0	0	0
Scotland	7	0	33	0	0	0	0
Sterling	3	0	16	0	0	0	0
Thompson	0	0	0	0	0	0	0
Windham	12	0	70	0	0	0	0
Woodstock	6	0	60	0	0	0	0
	63	1	496	1	0	1	0

*One apiary inspected twice.
†One bee paralysis.

SUMMARY

County	No. Towns	Apiaries Inspected	Apiaries Diseased	Colonies Inspected	Colonies Diseased	Foul Brood American	Foul Brood European	Sacbrood
Fairfield	17	54	7	712	25	25	0	0
New Haven	23	85	8	763	17	12	0	5
Middlesex	14	65	4	784	26	10	14	2
New London	20	84	1	1,619	1	1	0	0
Litchfield	24	158	6	1,402	10	10	0	0
Hartford	29	261	17*	1,900	25*	13	11	0
Tolland	12	82	2	347	8	8	0	0
Windham	10	63	1	496	1	0	1	0
	149	852	46	8,023	113	79	26	7

	No. Apiaries	No. Colonies
Inspected	852	8,023
Infested with European foul brood	9	26
Per cent infested	1.05	.324
Infested with American foul brood	36	79
Per cent infested	4.213	.98
Infested with Sacbrood	3	7
Infested with bee paralysis	1	1
Average number of colonies per apiary		9.41
Cost of inspection		$1,805.05
Average cost per apiary		$2.12
Average cost per colony		.225

Registration of Bees

Though Chapter 129, Public Acts of 1923, provides that all beekeepers shall register with the town clerk of the town in which the bees are kept, on or before October 1 of each year, the law is not enforced and only a portion of the apiaries are registered. In Stafford in 1924, one beekeeper was prosecuted and fined for failing to register, but I have not learned of any other case in Connecticut where the law has been enforced. In one town in 1928, the town clerk (a woman) telephoned to certain persons known to keep bees, with the result that all of them registered.

The law also provides that the town clerks shall report all such registrations to the State Entomologist on or before February 1, but does not require them to report in case no registrations have been made. Consequently, without investigating the matter, it is impossible to know whether the town clerk has failed to report the names registered or whether no bees have been registered in the town. Probably the General Assembly of 1929 will be asked to change this provision of the law.

The law as it now stands is as follows:

"Section 1. Every person owning one or more hives of bees shall, annually, on or before the first day of October, make application to the town clerk of the town in which such bees are kept, for the registration of such bees, and such town clerk shall issue to such applicant a certificate

*One colony had bee paralysis.

of registration upon the payment of a recording fee of twenty-five cents, which certificate shall be in the form prescribed and upon blanks furnished by the commissioner of domestic animals and shall be recorded in the office of such town clerk.

Sec. 2. A record of such registration and of the name and place of residence of the registrant and the definite location in the town where bees are kept by him shall be kept in a separate book in the office of the town clerk, which record shall be accessible to the public. Each town clerk shall file with the state entomologist of the Connecticut Agricultural Experiment Station a complete list of such registrations and locations on or before the first day of February of the year succeeding such registrations. Any town clerk failing to perform such duty shall be fined not more than ten dollars.

Sec. 3. Any owner of bees who shall fail to register as required by the provisions of this act shall be fined not more than five dollars."

All beekeepers should each year on or before October 1, register with the town clerk in the towns where the bees are kept.

All town clerks after October 1, should report complete data regarding such registration to the State Entomologist.

GIPSY MOTH WORK IN CONNECTICUT IN 1928

By W. E. Britton and John T. Ashworth

The work of suppressing the gipsy moth has been continued on the same plan as adopted in former years, by the State of Connecticut in cooperation with the Federal Bureau of Entomology. As the Federal forces have ever been chiefly interested in preventing the further spread of the insect, they have operated in the territory along the western border of the infested area. The State forces for the most part have worked in the territory further eastward which is known to be infested. We are greatly indebted to Messrs. A. F. Burgess and H. L. Blaisdell, in charge of the Federal work, for their hearty cooperation and we here express to them our thanks and appreciation.

Financial Statement

RECEIPTS

Appropriation for biennial period ending June 30, 1929	$100,000.00
Rebate on automobile insurance	199.04
Total	$100,199.04

EXPENDITURES

Salaries		$4,840.00
Labor		39,174.67
Stationery and office supplies		32.00
Sundry supplies		13.94
Communication service		
Telephone	$64.80	
Postage	11.24	
		76.04

Travel expenses		$270.36	
Gasoline		1,571.22	
Oil		730.72	
Transportation of things		60.86	
Printing (warning signs)		27.50	
Heat, Light, Water and Power:			
Fuel	$144.10		
Electricity	20.00		
		164.10	
Tools, machinery and appliances		663.75	
Spray materials		1,111.77	
Buildings and land			
Office rent	$ 12.00		
Rent of storehouse	300.00		
Storage of autos	328.50		
		640.50	
Contingent expenses			
Purchase of new Buick car	$1,262.00		
Medical services	2.00		
Insurance (liability):			
on autos	625.54		
fire and theft	81.39		
stock and fixtures	131.50		
Spray damage to auto	25.00		
		2,127.43	
Automobile repairs and supplies		1,538.53	
			$53,043.39
Balance			$47,155.65

Equipment

The Buick touring car used for the past three years, having reached the point of requiring frequent repairs, was exchanged for a new Buick sedan early in July, 1927. A Dodge touring car has nearly outlived its usefulness, and authorization has already been granted to exchange it for a Chevrolet sedan. Nine Ford light delivery trucks are used in transporting the scouts from their boarding places to the field, each crew having a truck in charge of the foreman. Two Netco trucks with Fitzhenry-Guptill pumps and 400-gallon tanks are used in spraying, and a horse-drawn power sprayer is available if needed.

During the year, 1,000 feet of new spray hose was purchased. This gives us about 3,500 feet of one-inch high pressure spray hose and 150 feet of suction hose.

The storehouse rented on North Main Street, Danielson, is provided with gasoline tank and pump, and is well equipped with small tools, Ford parts, tires and tubes, so that most of the repair work can be done by our own men.

Details of Work by Counties and Towns

The following pages contain a detailed account of the scouting, spraying and other control measures in the infested towns.

When egg-clusters are found, they are always saturated with creosote to kill the eggs. Complete statistics are given in the tables beginning on page 723 and are summarized on page 725.

WINDHAM COUNTY

The only scouting in Windham County this year was done in training men, with a little additional work in late spring, and was all confined to the three following towns:

Killingly—54 Infestations—2,437 Egg-clusters

Killingly was used as a training school this year, and the southern two-thirds of the town was scouted. The infestations found were not so large as in preceding years, but were closer together, indicating a more general infestation especially at the eastern end of the town near the Rhode Island State line. The largest colony found was in white oak woodland owned by G. E. Paine, situated on the Green Hollow road just south of Danielson; 598 egg-clusters were found and treated here. On the south side of the Providence pike just east of the village of South Killingly, 345 egg-clusters were found on six trees and in a stone wall. These were the only large colonies found in the town and spraying was done by State men in June.

Scotland—2 Infestations—6 Egg-clusters

Scouting in this town was started May 5, and two small infestations of three egg-clusters each were found, one in the southwestern corner of the town and the other about one mile north of the post office.

Sterling—8 Infestations—405 Egg-clusters

It was late in May before scouting was started in Sterling, and the eggs were hatching when the men found them. Before the town was completed, scouting had to be stopped, and spraying was started. Two large colonies were found just north of the Providence road near the Rhode Island line, one of 146 egg-clusters was on land owned by J. H. Brown and the other of 100 egg-clusters was a short distance southward on land owned by Henry Esklinen. Three places were sprayed by State men in June.

NEW LONDON COUNTY

New London—15 Infestations—660 Egg-clusters

Two large colonies were found in New London by a State crew this year, one of 230 egg-clusters on a white oak and in a stone

wall on Roosevelt Street, on land owned by Mr. McMahon, and the other of 211 egg-clusters on Glenwood Avenue, in the southern end of the town. These two infestations were the only large ones and the other colonies were distributed rather evenly throughout the town. Spraying was done by State men.

North Stonington

Before scouting could be started in North Stonington, the egg masses were hatching and the men had to start spraying; however, after the spraying was over men were sent to scout around locations where the pest had been found in former years. Altogether 342 pupae and larvae were found and destroyed.

Norwich—8 Infestations—1,007 Egg-clusters

Seven of the eight infestations found this year in Norwich were situated in the Greenville district, and two of them were large colonies. One of 760 egg-clusters was found to extend over several blocks west of North Main Street, and the other of 145 egg-clusters was on land owned by C. E. Jennings at 201 Hamilton Avenue. A large amount of spraying was done in Norwich by State men.

Old Lyme

In the season of 1922 three small infestations were discovered and treated in Old Lyme. As the territory around these places had since been scouted several times and nothing found, the work this year consisted of summer scouting around the old infestations; no larvae or pupae were found.

Stonington—39 Infestations—5,791 Egg-clusters

Fifty-seven egg-clusters were found this year in the village of Stonington where in the same territory 1,159 were found last year. This year 4,958 egg-clusters were found in the village of Pawcatuck where conditions were worse than in Stonington village last year. The trees of the entire village were sprayed, and it is hoped that the results will be as successful as in Stonington village last year. A large colony was found in woodland owned by H. C. Davis located on the east side of Quiambog Cove but the other infestations were small, most of them containing less than ten egg-clusters. Spraying was done by State men.

Bozrah—1 Infestation—970 Egg-clusters

One large colony was found in Bozrah on the west side of Bear Hill on two white oaks and in a stone wall on land owned by E. A.

Bishop about one-eighth of a mile back from the road. A majority of the 970 egg-clusters were in the stone wall. This infestation was sprayed by State men.

East Lyme

The work in East Lyme this year consisted of scouting for larvae around the places where the gipsy moth had occurred before; 16 pupae were found and destroyed by State men.

The towns of Franklin and Ledyard were also scouted but nothing found.

Groton—9 Infestations—76 Egg-clusters

None of the infestations found in Groton this year were large; two of 20 egg-clusters each were located in the southwestern end of the town, one on apple trees in Schnescotte Park, the other on maple, cherry and apple trees and in a stone wall at Branford Farms. The spraying was done by State men.

Lebanon—14 Infestations—3,216 Egg-clusters

All but one of the infestations in this town were situated in the northern half; in fact, ten of the fourteen were in the extreme northern end, and it looks as if the entire spread had come from a woodland colony on land owned by Mr. Lieberman between Sweet Hill and Lebanon Village. Altogether 2,209 egg-clusters were found in this colony. A colony of 317 egg-clusters was found in the margin of a woodland owned by Mr. Blakesly just east of Lebanon Street, and the next largest colony was one of 211 egg-clusters found in woodland owned by the Boston Club. These three infestations contained more than 80 per cent of the total number of egg-clusters found in the town. State men sprayed around these infestations.

MIDDLESEX COUNTY

East Haddam

East Haddam was the only town scouted in Middlesex County this year and no trace of gipsy moth was found.

TOLLAND COUNTY

Columbia—11 Infestations—3,106 Egg-clusters

The infestations in Columbia were all situated in the southwestern part of the town and all but two of them occurred in wooded areas. The largest infestation contained 1,815 egg-clusters scat-

ered throughout a large block situated on both sides of the State road leading from Hebron to Columbia, near the Hebron town line. A colony of 514 egg-clusters was found just east of the one mentioned, in woodland and orchard owned by Mr. Bailey and Mr. Topple. These were the largest colonies although four others of 100 or more egg-clusters each were found in the town. Spraying was done by State men.

Coventry—6 Infestations—515 Egg-clusters

Two large colonies were found in Coventry this year by a State crew, one of 215 egg-clusters in woodland owned by B. Hyde, and situated about a mile south of Coventry village. The other was in an oak grove owned by E. A. White, just across the Willimantic River from Eagleville where 215 egg-clusters were found. The spraying was done by State men.

Ellington—25 Infestations—704 Egg-clusters

Most of the infested territory in Ellington lies in the northern part of the town between the State road leading to Somers and Crystal Lake, and most of the colonies were small. Two woodland colonies are mentioned here as they are stiuated on the high ridge extending south from Soapstone Mountain and are open to windspread, one containing 204 egg-clusters on land owned by Joe Witiuk, and the other of 101 egg-clusters on land owned by F. L. Worthington. State men did the spraying.

Hebron—8 Infestations—813 Egg-clusters

Six of the eight infestations found this year were located in the southwestern end of the town. Two of the largest were woodland colonies, one of 353 egg-clusters on land owned by Messrs. Adler and Staba, and the other of 242 egg-clusters on land owned by Mrs. Adela White. The spraying was done by State men.

Mansfield—34 Infestations—2,772 Egg-clusters

Mansfield was scouted this year for the first time since 1924, and the degree of infestation has greatly increased since that time. The infestations were found scattered over the whole town, the largest colonies occurring in the northeastern or Wormwood Hill section. Colonies of 536, 269, 255, and 241 egg-clusters were discovered in woodlands owned respectively by Messrs. Sulkowski, Feingold and Smith. Though these colonies were the largest found in the town, there were several of 100 or more egg-clusters each. The spraying in this town was done by State men.

Somers—19 Infestations—1,431 Egg-clusters

Two large colonies were found in Somers this year by a State crew, both situated nearly on the Massachusetts State line north of North Somers. One of 477 egg-clusters on apple, maple and pine trees also in a stone wall, the owner of which could not be found; the other was in apple, maple and oak trees on land owned by Anthony Joonelas. The rest of the infestations, although spread separately over the town, were all small. State men did the spraying.

Stafford—113 Infestations—4,353 Egg-clusters

Stafford is generally infested throughout the entire township; in fact, it is in about the same condition as Thompson, Woodstock and Union. Only two really large colonies were discovered, the others being of medium size. Both colonies mentioned above were located in the Stafford Springs district, one of 279 egg-clusters on land owned by Malone Moore and Fred Ruby, and the other of 258 egg-clusters was on the Cyril Johnson Woolen Company's property on High Street. Spraying was done by State men.

Tolland—3 Infestations—119 Egg-clusters

In Tolland, 110 of the 119 egg-clusters found this year were in white oaks just north of Tolland Village on land owned by E. Ewald; the other nine egg-clusters were in two colonies of five and four egg-clusters each found on land owned by J. D. Cohen, near the Ellington town line. The spraying was done by a State crew.

Vernon—2 Infestations—120 Egg-clusters

A colony of 117 egg-clusters was discovered by a State crew in Vernon this year about one mile north of Vernon Center, in pasture oaks owned by Mr. Dougherty. About the same distance east of the village, another of three egg-clusters was found in oak woodland. Both places were sprayed by a State crew.

Willington—34 Infestations—1,104 Egg-clusters

All but three of the infestations in Willington were in the northern half of the township; these were small and found from East Willington southward along the Ashford town line. There were two large colonies found in the northwestern part of the town, one on apple trees and in a woodland owned by P. Figura, containing 285 egg-clusters, and one of 264 egg-clusters on 14 trees around Mr. P. Halchek's house. The rest of the colonies were small and of one year's standing. State men did the spraying in this town.

HARTFORD COUNTY

East Windsor—1 Infestation—1 Egg-cluster

A single egg-cluster was found in a maple tree owned by Mrs. Cushman, situated about one and one-half miles west of Windsorville on the north side of Keach Brook, this being the only trace of the gipsy moth found by the State scouts in this town. No spraying was thought necessary.

Enfield—1 Infestation—6 Egg-clusters

A small colony of six egg-clusters was found in one white oak tree in a field owned by Mrs. Elizabeth Pierce, about two miles south of Hazardville. One egg-cluster was found at this place in 1922. This colony was sprayed July 2 by State men.

Granby—24 Infestations—1,580 Egg-clusters

This town was used by the Federal forces to train men before sending them into the outside territory. In addition to the roadside scouting, 280 acres of woodland were scouted, divided into eight separate blocks. The bulk of the infestations are still confined to the southwestern corner of the town where the largest colonies were found. There were two of them, one of 870 egg-clusters in the woodland owned by Max Shinder, and the other of 262 egg-clusters in woodland owned by Mr. Lapion. Just north of these colonies was found an infestation of 108 egg-clusters in an orchard owned by Andrew Boris. The spraying was done by State men and over three-quarters of a ton of dry arsenate of lead was used.

Hartford—4 Infestations—151 Egg-clusters

One colony of 124 egg-clusters was found on property owned by Professor Paton, at No. 50 Forest Street, and another of 18 egg-clusters on roadside trees at the corner of Farmington Avenue and South Marshall Street. Both of these infestations were sprayed on July 3 by State men.

Hartland—5 Infestations—583 Egg-clusters

The Federal forces used Hartland for training men the same as Granby. The two largest colonies were found on property owned by Mr. Lichdi, in the northeast corner of the town. One was in woodland and contained 209 egg-clusters, and the other was a colony of 144 egg-clusters in an orchard. Both these colonies and another small infestation of seven egg-clusters in Mr. Eddy's orchard were sprayed by State men.

Suffield—9 Infestations—259 Egg-clusters

Only one colony of considerable size was found this year in Suffield. This was in woodland owned by the Berkshire Ice Co., of Southwick, Mass., situated on the western side of the town near Lake Congamond. This and a small infestation in a pasture were sprayed on July 2 by State men.

Wethersfield—1 Infestation—715 Egg-clusters

A large colony of 715 egg-clusters was found this year in Wethersfield on meadow land owned by E. Isaacson, near the bend of the Connecticut River. When the crew scouted this territory a lot of the land was covered with water so the ground work could not be done. In June, the spraying machines were sent there in an attempt to spray the trees but on account of two days of rain, the land was flooded and the sprayers had to be removed. They were sent to other parts of the state to continue the work, but later they returned and had sprayed about four and one-half acres of woodland when similar conditions arose and the work had to be abandoned for this season.

In the following towns—Bloomfield, Bristol, Burlington, Canton, New Britain, Simsbury, South Windsor and West Hartford —work was confined to scouting the territory around last year's infestations, and no re-infestations were found in any of these towns. The towns of Rocky Hill, Windsor and Windsor Locks were completely scouted and no infestations found.

LITCHFIELD COUNTY

The only work done by State men in Litchfield County consisted in scouting around last year's infestations in the three towns of Harwinton, New Hartford and Plymouth. One egg-cluster was found near an old infestation in Harwinton, but nothing was discovered in the other two towns. All other work in Litchfield County reported in this paper was done by Federal men. Without their help it would have been impossible to have covered so much territory. More towns were scouted in this section of the State in 1927-1928 than has been covered in one season for several years.

Barkhamsted—4 Infestations—748 Egg-clusters

Of the total number of egg-clusters discovered in Barkhamsted this year, 722 were found in woodland owned by C. LeGeyt, situated on the eastern edge of the town near the Granby line. This colony seemed to have spread from the large colony on Mr. Shinder's property in the southwestern corner of Granby. The

three other infestations were all in woodland and all very small. Spraying was done at two of the colonies by State men.

Canaan

Federal men scouted 1,082 acres of woodland this year in Canaan; this was territory in and around old infestations and no trace of the gipsy moth was found.

Colebrook—1 Infestation—46 Egg-clusters

One colony of 46 egg-clusters was found on fruit and shade trees owned by Frank Williams, situated about two miles west of the Colebrook Post Office.

Cornwall—9 Infestations—280 Egg-clusters

All nine infestations found in Cornwall this year were situated in a cluster around and on South Mountain, which is in the southwestern part of the town near Cornwall Bridge. The two largest were woodland colonies on land owned by Dr. W. C. Clark and contained 83 and 61 egg-clusters respectively; two other colonies were found on Dr. Clark's property. One colony of 60 egg-clusters and three smaller ones were on property owned by Mr. Patterson. About 180 acres of woodland were sprayed at these infestations, nearly a half ton of lead arsenate being used.

Goshen—1 Infestation—1,626 Egg-clusters

A large colony of 1,626 egg-clusters was found in Goshen in woodland owned by the Waterbury Water Company, situated directly south of the West Goshen Post Office, near the Litchfield line. Twenty-five and one-half acres of woodland were sprayed by Federal men.

New Milford

The scouting in New Milford this year was confined to the territory around last year's infestation, in southern end of the town, where about 1,518 acres of woodland were scouted and nothing found.

Norfolk—7 Infestations—162 Egg-clusters

The infestations (as in the case of Cornwall) were all grouped in the northeastern corner of the town, all in woodland and the two largest were colonies of 52 and 49 egg-clusters, on land owned by Mr. Laitinen and the Doolittle Lake Company, respectively. A Federal crew sprayed five of the colonies, and over one and one-

quarter tons of dry arsenate of lead were used in spraying 101 acres of woodland. In one place nearly a mile of hose was necessary to reach the infested trees.

North Canaan—3 Infestations—68 Egg-clusters

Three small colonies were found about one mile east of East Canaan, in woodlands owned by James Rosier, Max Sivan and B. Stevens, where 32, 31 and five egg-clusters were found in the order named. The spraying was done by Federal men on June 11 and 12.

Salisbury—1 Infestation—16 Egg-clusters

One small colony of 16 egg-clusters was found in woodland owned by F. C. Hood, located west of Falls Village and just south of Mount Prospect. Eleven acres were sprayed between July 3 and July 7 by a Federal crew.

Sharon—2 Infestations—22 Egg-clusters

Two colonies, one of 13 egg-clusters in woodland owned by Fred Gobilot and one of nine egg-clusters in woodland owned by A. B. Curtis were the only infestations of gipsy moth found in Sharon this year. Both colonies were located in the southwestern end of the town near Skiff Mountain. Altogether fifteen and one-half acres of woodland were sprayed at both places by Federal men.

The towns of Litchfield and Winchester were also scouted and no infestations found.

FAIRFIELD COUNTY

The only town in this county where any gipsy moth work was done this year was Greenwich. In 1926 a large infestation was discovered there; clean-up work was carried out and when the town was scouted again in 1927, nothing was found. This year the work was confined to the area around the old infestation and again nothing was found so it is hoped that the colony has been eradicated. This work was done by Federal men.

NEW HAVEN COUNTY

Wallingford—1 Infestation—4,505 Egg-clusters

Wallingford was again found to be infested with the gipsy moth when a Federal crew scouted the town this year, a woodland colony of 4,505 egg-clusters was discovered in the north-

western corner of the town near the Meriden and Cheshire lines. This was the only infestation found in the county this year although 17 other towns were scouted by Federal men. At the colony in Wallingford the dead wood and brush was cut and burned during the late winter and spring to make it easier to spray and thus eradicate this isolated colony. Altogether, 92,800 gallons of spray liquid were used in 130 acres of woodland and a small orchard of 10 apple trees, and it is hoped that the colony has been eradicated.

The seventeen towns scouted in the county were Ansonia, Beacon Falls, Bethany, Cheshire, Derby, East Haven, Hamden, Middlebury, Milford, Naugatuck, New Haven, Orange, Oxford, Prospect, Seymour, Wolcott and Woodbridge.

STATISTICS OF INFESTATIONS 1927–1928.

Towns	No. Infestations Found	No. Egg-clusters Creosoted	No. Colonies Sprayed	No. Lbs. Poison Used	No. Larvae and Pupae Killed	No. Miles Roadway Scouted
Windham County:						
Killingly	54	2,437	4	45	590	29
Scotland	singles	6	0	0	0	34
Sterling	8	405	3	45	0	11
	62	2,848	7	90	590	74
New London County:						
Bozrah	1	970	1	12	25	42
East Lyme†	0	0	0	0	16	
Franklin	0	0	0	0	0	53
Groton	9	76	1	19	412	56
Lebanon	14	3,216	3	42	135	130
Ledyard	0	0	0	0	0	45
New London	15	660	9	70	234	23
North Stonington†	0	0	0	0	342	
Norwich	8	1,007	6	585	0	73
Old Lyme†	0	0	0	0	0	0
Preston	3	157	1	175	0	33
Salem	1	42	1	25	0	46
Stonington	39	5,791	10	1,750	252	52
	90	11,919	32	2,678	1,840	553
Tolland County:						
Columbia	11	3,106	3	150	709	65
Coventry	6	515	2	87	6	102
Ellington	25	704	1	438	11	98
Hebron	8	813	2	850	260	100
Mansfield	34	2,772	3	75	190	99
Somers	19	1,431	9	502	124	69
Stafford	113	4,353	51	1,124	0	159
Tolland	3	119	2	62	5	104
Vernon	2	120	2	112	0	67
Willington	34	1,104	14	110	0	129
	255	15,037	89	3,510	1,305	992

†Scouted by State men around old infestations.

Towns	No. Infestations Found	No. Egg-clusters Creosoted	No. Colonies Sprayed	No. Lbs. Poison Used	No. Larvae and Pupae Killed	No. Miles Roadway Scouted
Middlesex County:						
East Haddam	0	0	0	0	0	165
Hartford County:						
Bloomfield†	0	0	0	0	0	
Bristol	0	0	0	0	0	5
Burlington	0	0	0	0	0	9
Canton†	0	0	0	0	22	
East Windsor	1	1	0	0	0	79
Enfield	1	6	1	12	4	96
Granby*	24	1,587	9	1,555	545	95
Hartford	4	151	2	50	95	167
Hartland*	5	385	3	560	39	64
New Britain†	0	0	0	0	0	
Rocky Hill	0	0	0	0	0	38
Simsbury†	0	0	0	0	0	
South Windsor	0	0	0	0	0	9
Suffield	9	259	2	550	94	85
West Hartford	0	0	0	0	0	6
Wethersfield	1	715	1	270	318	45
Windsor	0	0	0	0	0	81
Windsor Locks	0	0	0	0	0	30
	45	3,104	18	2,997	1,117	809
New Haven County:						
Ansonia*	0	0	0	0	0	43
Beacon Falls*	0	0	0	0	0	23
Bethany*	0	0	0	0	0	62
Cheshire*	0	0	0	0	0	93
Derby*	0	0	0	0	0	32
East Haven*	0	0	0	0	0	65
Hamden*	0	0	0	0	0	102
Middlebury*	0	0	0	0	0	61
Milford*	0	0	0	0	0	86
Naugatuck*	0	0	0	0	0	66
New Haven*	0	0	0	0	0	210
Orange*	0	0	0	0	0	57
Oxford*	0	0	0	0	0	77
Prospect*	0	0	0	0	0	41
Seymour*	0	0	0	0	0	55
Wallingford*	1	4,505	1	4,640	0	131
Wolcott*	0	0	0	0	0	51
Woodbridge*	0	0	0	0	0	55
	1	4,505	1	4,640	0	1,310
Litchfield County:						
Barkhamsted*	4	748	2	450	0	84
Canaan*	0	0	0	0	0	(1,082 acres)
Colebrook*	1	46	0	0	0	70
Cornwall*	9	280	9	9,650	0	104
Goshen*	1	1,626	1	1,825	0	90
Harwinton†	0	1	0	0	0	
Litchfield*	0	0	0	0	0	140

*Scouted by Federal Men.
†Scouted by State men around old infestations.

Towns	No. Infestations Found	No. Egg-clusters Creosoted	No. Colonies Sprayed	No. Lbs. Poison Used	No. Larvae and Pupae Killed	No. Miles Roadway Scouted
Litchfield County—*cont.*						
New Hartford†....	0	0	0	0	0	
New Milford*.....	0	0	0	0	0	(1,518 acres)
Norfolk*.....	7	162	5	2,595	0	85
North Canaan*....	3	68	1	100	0	56
Plymouth†.....	0	0	0	0	0	
Salisbury*.....	1	16	1	920	1	110
Sharon*.....	2	22	2	1,120	0	140
Winchester*.....	0	0	0	0	0	100
	28	2,969	21	16,660	0	979
Fairfield County:						
Greenwich‡.....	0	0	0	0	0 (12 acres)	

SUMMARY OF STATISTICS

County	No. Towns Covered	No. Infestations Found	No. Egg-clusters Creosoted	No. Colonies Sprayed	No. Lbs. Poison Used	No. Larvae and Pupae Killed	No. Miles Roadway Scouted
Windham..	3	62	2,848	7	90	590	74
New London	13	90	11,919	32	2,678	1,840	553
Tolland....	10	255	15,037	89	3,510	1,305	992
Middlesex..	1	0	0	0	0	0	165
Hartford...	18	45	3,104	18	2,997	1,117	809
New Haven.	18	1	4,505	1	4,640	0	1,310
Litchfield..	15	28	2,969	21	16,660	0	879
Fairfield...	1	0	0	0	0	0	0
	79	481	40,382	168	30,575	4,852	4,882

Parasite Work

This branch of the work is carried on year after year in cooperation with the Federal laboratory at Melrose Highlands, Mass. In the Report of the Connecticut Agricultural Experiment Station for 1922, page 313, will be found brief accounts of the different species of parasites and the matter need not be repeated here. This year, the egg parasite, *Anastatus bifasciatus,* only was liberated, and the following table gives the towns and number of individuals liberated in each town. The method previously followed in trying to get these enemies of the gipsy moth established has been to put them out at places where the moths are abundant and a year after make collections of egg-clusters if they could be found, to see if any of the parasites could be recovered. A large number of the towns in the eastern end of the State have been so treated and but few recoveries have been made, so this year another method is being tried. Thus in Thompson, two plots of woodland, one of 84 acres, the other of 48 acres, and in Eastford

*Scouted by Federal men.
†Scouted by State men around old infestations.
‡Scouted by Federal men around old infestatoins.

a plot of 50 acres, were laid out in one and two-acre sections. There was also a check plot laid out in each town, and all plots were then scouted for egg-clusters and the average number in each plot estimated. Then the parasites were planted according to the degree of infestation. Collections have been made at the different plots this winter but as the results have not been fully tabulated at this time, a more complete report will be made at a later date.

List of Towns and Number of Anastatus Parasites Liberated in Each Town During Season, 1927–1928

Towns	No. of Individuals
Thompson*	104,000
Eastford*	50,000
Mansfield	99,000
Willington	41,000
Coventry	25,000
Hebron	35,000
Columbia	71,000
Lebanon	40,000
Stonington	35,000
	500,000

Defoliation

Up to this time there has never been any noticeable defoliation of trees in Connecticut by gipsy moth caterpillars. Yet we are confident that hundreds of acres would have been defoliated long before this had the insect not been kept in check by the suppression work conducted by the State. In 1924 we were very optimistic regarding the parasites which seemed to be making themselves felt in many localities where they apparently caused an actual reduction of the gipsy moths. But something has happened to the parasites since 1924. In 1925 they were much less abundant and the gipsy moth became more prevalent, and the following year there were large stripped areas of woodland in Massachusetts. In 1924, about 825 acres were defoliated in Massachusetts, this being considered the minimum for 20 years. In 1928, occurred the most severe defoliation in recent years, estimated at 262,000 acres, about half of the area being in Massachusetts and the other half in New Hampshire and Maine.

Present conditions are very grave and there should be no reduction in suppression work for the next few years.

Quarantine

No new towns have been placed in the quarantined area in Connecticut during the past year, but 31 towns shown in Fig. 57,

*Thompson and Eastford were used for re-colonization experimental plots.

formerly in the lightly infested quarantined area (colored green on the Federal map) have been placed in the generally infested area (colored red on the Federal map). These towns are as follows: Barkhamsted, Litchfield County; Bloomfield, Canton, East Granby, Glastonbury, Granby, Hartford, Hartland, Simsbury, Suffield, Wethersfield, Windsor and Windsor Locks, Hartford County; Andover, Columbia and Hebron, Tolland County; Bozrah, Colchester, Franklin, Griswold, Groton, Lebanon, Ledyard, Lisbon, New London, North Stonington, Norwich, Preston, Sprague, Stonington, and Voluntown, New London County.

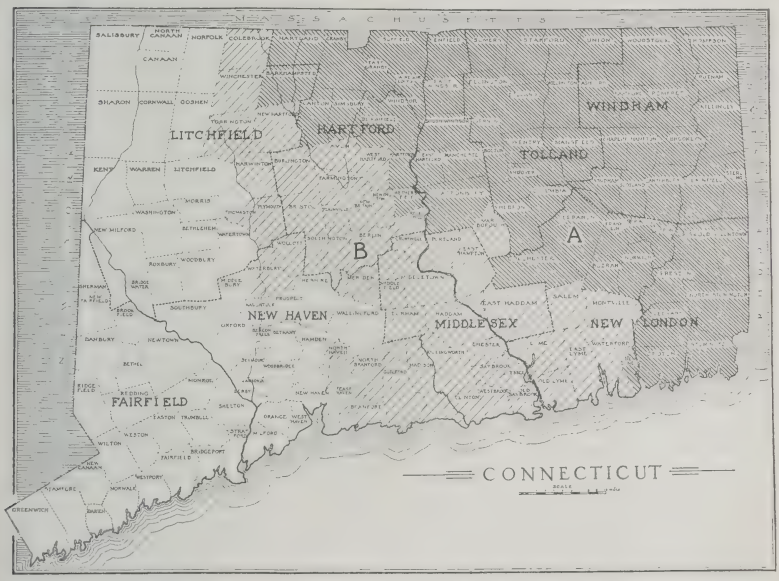

FIG. 57. Map of Connecticut showing present quarantined areas. A, generally infested; B, lightly infested.

RECOMMENDATIONS

In view of the present situation, we felt like requesting an increased appropriation for gipsy moth work for the biennial period ending June 30, 1931, but later decided to ask for the same amount as granted for the present biennium, but in doing so to also file a statement calling attention to the gravity of gipsy moth conditions at the present time. We therefore recommend that an appropriation of $100,000.00 be granted for the next two years, by the General Assembly of 1929. We believe this to be inadequate and that some noticeable defoliation may occur in 1929 or 1930.

NOTES ON FRUIT INSECTS IN 1928

By M. P. Zappe

During the spring and early summer of 1928, some observations were made on fruit insects while visiting orchards throughout the State. At harvest time some fruit in each of a few orchards was scored to check up on the early observations and to see how successful the fruit growers had been in carrying out their spray programs.

The European red mite, *Paratetranychus pilosus* C. and F., was quite abundant early in the season. Many eggs were seen at Bantam, Cheshire, East Hampton, Guilford, Hamden, Madison, Milford, New Canaan, South Glastonbury, Southington, Unionville, Wallingford and Wilton. From the numbers of eggs present, it looked as though there would be a heavy infestation by the middle of summer, but the mites did not reproduce as fast as expected, probably due to weather conditions. Only in one or two cases were mites present in large enough numbers to cause injury. Late in the fall, however, there were many eggs present on the trees and many apples at harvest time had mite eggs in the calyx cup.

Aphids were very scarce in the spring. On some trees where counts were made, only about one aphid per ten buds could be seen. Many of these had been killed by the delayed dormant spray applied by the orchardist. Not many aphids developed during the summer and practically no injury to fruit resulted.

Leaf hoppers hatched in about the usual numbers in the spring, but the wet weather was unfavorable for their development. By the middle of July, many had been killed by a fungous disease and were left dead upon the leaves.

Fall cankerworms, *Alsophila pometaria* Harris, were present in the orchards early in the season doing a little damage in Durham, Hamden and South Glastonbury. Orchards that received the prepink and pink sprays showed very little cankerworm injury.

The plum curculio, *Conotrachelus nenuphar* Hbst., did the usual amount of damage this year. Apple orchards near peach orchards always show the largest amount of damage nearest the peach orchard. Many curculios are produced in the early dropped peaches and these often come into the apple orchard. Wild apple trees that are never sprayed are another source of infestation. Fruit scored from several orchards during the fall showed that there was considerable injury caused by curculios. Most of this injury, however, would not be so great as to reduce the value of the fruit. In most cases where the infestation is very heavy, some of the fruit is worthless and is thrown into the culls.

In Cheshire, Baldwin apples from four orchards were scored and 12, 16, 17 and 22 per cent of the fruit was marked by cur-

culios. In Branford two orchards showed three and eleven per cent injured, and in East Wallingford three, seven, and 14 per cent. All fruit scored was from sprayed trees.

Several vineyards in South Glastonbury were severely injured by the grapevine flea-beetle, *Haltica chalybea* Ill. The injury is done by the adult insect which eats out the swelling buds in early spring, thus destroying the embryonic fruit clusters. The injury is usually most apparent on the outside rows of the vineyard and on the ends of the rows. When the vines leaf out, both adults and larvae feed on the leaves. This insect also feeds on wild grapes and Virginia creeper. The remedy is either hand picking of the early adults, or spraying with a heavy dose of arsenate of lead, two pounds of dry poison per 50 gallons of water. This should be applied when the first beetles appear. After the vines have leafed out, another application of arsenate of lead will kill the young larvae. This will reduce their numbers so that fewer adults will be present the following year.

PLANT BUG INJURY TO FRUITS

By Philip Garman

During June, 1928, peaches on several trees growing on the Experiment Station grounds in New Haven were noticed to be injured severely by a kind of puncture which caused small sunken areas from which gum exuded. As a result of this attack, practically all of these peaches either dropped from the trees or were so deformed as to be worthless. The peach trees are situated near the west boundary of the Station grounds and nearby on the adjoining premises are several black oak trees of medium size. On investigation, it was found that plant bugs of the family Miridae, had migrated from the oak trees to the peach trees and were responsible for the injury to the fruit. The main migration from the oaks which were not over 50 feet away came in June when an examination of the fruit showed the bugs present and sucking the juices. On these peach trees 100 per cent of the fruit was affected.

Preliminary tests were made with nicotine dust as a control and it was found that the bugs could be brought down from the trees with this material though not all were killed. Numerous applications would probably have to be made to keep the trees free at the time when the insects are migrating. According to observations made by Caesar and Ross, there is little danger to trees planted a hundred yards or more from oaks. This fact should be considered in laying out a new orchard of peach trees, and has important bearing in case removal or treatment of the nearby oaks is thought expedient.

The species involved are *Lygus quercalbae* Knight and *Lygus omnivagus* Knight, both of which were found infesting the

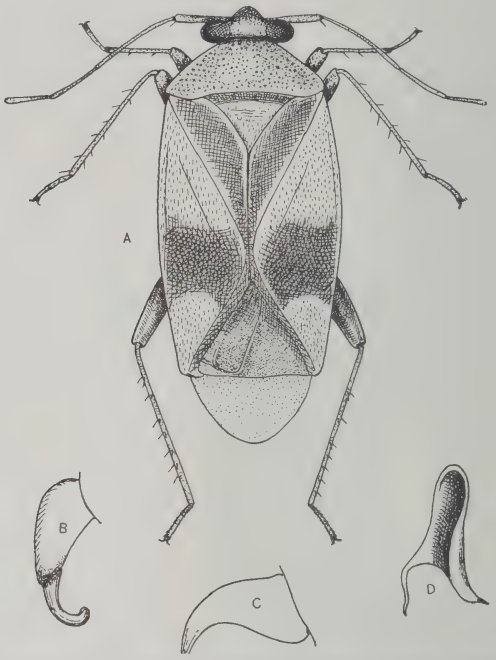

FIG. 58. A plant bug, *Lygus omnivagus* Knight which injured peaches. A, adult bug; B, right clasper, ventral aspect; C, left clasper, lateral aspect; D, left clasper, dorsal aspect.

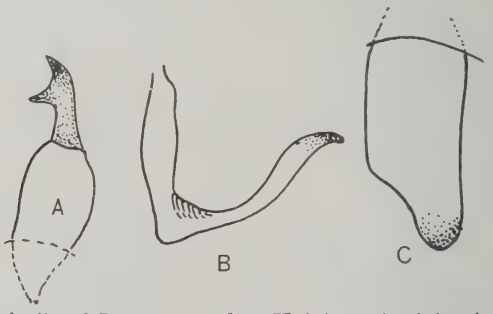

FIG. 59. Genitalia of *Lygus quercalbae* Knight. A, right clasper, ventral aspect; B, left clasper, dorsal aspect; C, left clasper, lateral aspect.

peaches at New Haven. They are closely related species and similar in general appearance, the species *L. omnivagus* being represented in Fig. 58, and the damage to the fruit on Plate XXI.

Injury of the type described is also credited to *L. caryae,* Knight, a species normally developing on hickory, and of course, the common tarnished plant bug, *L. pratensis* Linn., developing on weeds of various kinds, sometimes causes trouble. The injury by these pests is known as "cat-facing" in some sections due to the peculiar formation of the peach sometime after the damage has been done. On pears, damage appears to result in deformed fruits rather than the "cat-faced" condition, and in some orchards appears to be worse with the Bosc variety than others.

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THE ORIENTAL PEACH MOTH

By Philip Garman

The Oriental peach moth, *Grapholitha* (*Laspeyresia*) *molesta* Busck, was active in Connecticut in 1928, becoming very destructive in some orchards where little damage was done heretofore. In a few orchards it decreased in abundance, due probably to continued action of parasites and certain orchard practices of the growers. It has now been present in some orchards of East Wallingford for four years, causing a percentage of wormy fruit variously estimated at 50-100 per cent. In a few orchards within the heavily infested district, the pest has been slow in establishing itself, not having as yet become commercially important.

The areas where commercial damage was done in Connecticut are shown on the map (Fig. 60), the shaded portions indicating limits of commercial damage. The greatest damage last year was done in the south central district indicated by the heavy black. Orchards in this area varied in their degree of infestation, but the worst affected ranged from 50-100 per cent in Hileys and Elbertas. The pest was reported this year for the first time to be doing commercial damage in New London County. In Hartford County the infestation is still uneven, but some orchardists experienced severe losses. Fairfield and New Haven counties seem to be about the same as last year with perhaps more orchards on the whole infested. The infestation was particularly severe in quinces, practically every quince orchard in New Haven county

being infested, with much wormy fruit appearing on the local market. Quinces seem to be particularly attractive to the moths as indicated by the number of larvae obtained from a single bushel of discarded fruits. Over 600 were obtained from this bushel and it was estimated that fully 1,000 were originally present because of the number of exit holes found in the fruit when obtained.

At our suggestion, one orchardist, Mr. S. R. MacDonald kindly dusted his quinces four times at weekly intervals beginning August 10. Another grower, Mr. J. H. R. Bishop, alternated sprays

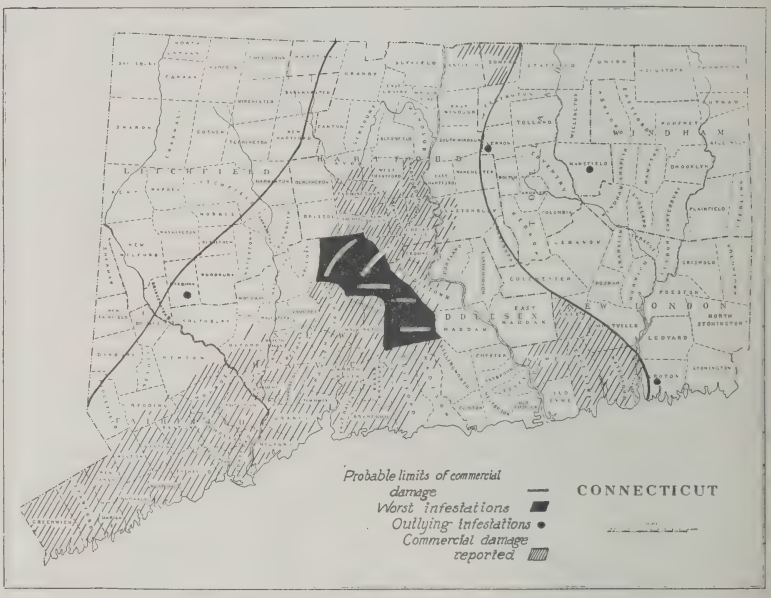

FIG. 60. Map of Connecticut showing distribution of the oriental peach moth in 1928.

with dusts beginning about the same date and making four applications in all. Both treatments failed to control the peach moth. In addition, two trees at the Experiment Station were used, one receiving five sprays of lead arsenate (1 oz.-2 gals.) on the following dates—August 9, 15, 25, 31 and September 8. Fifty-two per cent of the fruit was found to be wormy on examination and 111 larvae were obtained from the sprayed tree, whereas 96.1 per cent of the check fruit was infested and a total of 146 larvae found on examination. The latter test indicates some reduction, but inasmuch as it involves only two trees cannot be considered significant until confirmed by further experiments.

During 1928, tests were begun with ovicides and repellents and it was found that a materially increased kill could be obtained with one per cent white oil emulsions combined with various contact poisons, over that previously reported for nicotine-soap combinations. The most successful this year was a combination of white oil emulsion and pyrethrum soap, it being noted that many of the young larvae walking over the material were killed. The re-

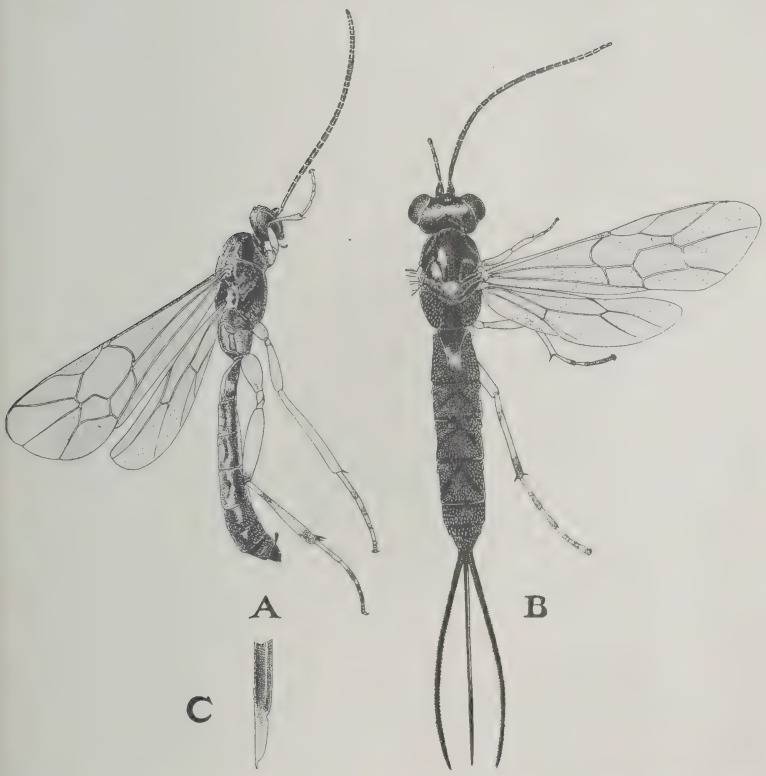

FIG. 61. *Glypta rufiscutellaris* Cresson, a parasite of the oriental peach moth. A, adult male, side view; B, adult female dorsal view; C, tip of female ovipositor.

sults of several years' tests with lead arsenate and fluosilicates and some of the fluorides indicate that these are effective killing agents for the recently hatched larvae. Perhaps the most promising yet discovered, however, has been reported by Dr. Driggers of the New Jersey Experiment Station, who reports the successful use of talc and mica dusts. Since these are very cheap and non-injurious, they should prove valuable in combatting the peach moth.

Dr. Stearns of Ohio has experimented with heavy lime sprays and finds them successful in reducing the infestation. He uses as much as 25 pounds of lime in 50 gallons of water. About 12 different dilute combinations were tried on the overwintering larvae in 1928 without success. Mr. Ross of Canada, however, reports a very good kill of these larvae with certain tar acid oils used at 10-15 per cent strength. Bait pans continue to be used in indicating the different broods, but no experimenters have yet obtained any great reduction in infested fruit from their use. They should form a valuable adjunct to the spray schedule in indicating the best time for spray applications.

Limited investigations were carried on with parasites and collections made from various orchards to determine the amount of parasitism. In general, it may be stated that those orchards most heavily infested had fewer parasites, which was particularly true of the Rogers orchard at Southington and the Young orchard at East Wallingford. Very few parasites of the second brood larvae infesting twigs yere found. The most important parasite found this year was *Glypta rufiscutellaris* Cresson (Fig. 61) which was obtained at New Haven late in the season. The parasite began emerging August 29 and continued until October 18. Larvae of the peach moth were exposed in cages with the parasites and oviposition observed by Mr. J. F. Townsend, the female inserting the ovipositor in the end of an infested twig. The egg parasite *Trichogramma minutum* Riley was observed early in the season by Mr. Walden who found it parasitising the eggs of the imported currant worm (*Pteronidea ribesi* Scopoli) on June 4. The same parasite was obtained in field cages from the eggs of the Oriental peach moth beginning July 26 and continuing until September 24. Parasites emerged from eggs parasitized on the latter date but did not hibernate.

CORN BORER CLEAN-UP OPERATIONS ON THE 1927 INFESTATIONS

By M. P. Zappe

The work of cleaning up the infestations of the European corn borer found in 1927 was begun in the fall of 1927 when the infested corn and weed areas in the towns of Milford and Oxford were burned. During 1928 no infestations were found in either of these towns.

The other 1927 infestations were all in the southeastern part of the State in the shore towns of Stonington, Groton, and East Lyme. These towns have been infested for several years, but no spread has been found outside their borders.

Actual burning work started in East Lyme on March 15, and, though machinery and men were ready to work a few days earlier, weather conditions prevented it. Work in East Lyme was completed on March 26. In this town the village of Niantic was generally infested and a few infestations were on the Crescent Beach road south and west of the village. The infestations were mostly in backyard gardens and in some small fields of corn just outside the village. Most of the work was done with hand burners. A machine burner was used in some of the larger fields, but was not very satisfactory because the fields were too small to make its use economical. The machine burner consists of a battery of nozzles on a long pipe through which the oil is forced. Just behind the nozzles is a large metal shield to protect the men from the heat. This is all mounted on wheels and is drawn very slowly over the fields of infested material by several men. About 35 acres of corn and weed areas were burned in Niantic, requiring 231 man days to complete the work.

From Niantic the burning crew was shifted to the town of Groton where there were two centers of infestation. One was on the top of Fort Hill and the other in the village of Noank. At Fort Hill the machine burner was used in one large field. Other fields had been plowed. The corn that was not completely plowed under was picked up and burned. There was much corn in a pasture, which had been partly eaten by cows. The uneaten portions were raked and picked up and were burned without the aid of any oil. At Noank all infestations were in backyard gardens and all clean-up work was done with hand burners. Approximately 12 acres of gardens were either cleaned by raking and picking up infested material or burned without any preliminary raking. It required about 133 man days to clean up the town and the work was done between April 14 and April 21. In the town of Stonington, there were five centers of infestation. One was south of Mystic railroad station in a small market gardening section. The largest fields were machine burned and smaller areas were burned with hand burners as were the edges of the larger fields. Another infested section was north of Mystic about half way between Mystic and Old Mystic. This area consisted of fairly large fields of corn and weeds and was burned by the carriage burners except for a few small areas and around the edges of the fields. This section was infested in 1925 but no infestations were found in 1926.

One infested area was at the Industrial Place, Mystic, where the infestations were found in small gardens and in one large cornfield near the infested gardens. This area was also infested in 1926. Small backyard gardens were burned over with hand burners and the large fields with machine burners.

Another infested section was just north of Stonington borough and was mostly in small back yards. Both machine and hand burners were used here. This area was almost continuous with the next which was at Wequetequock. These were only about one mile apart. At the Wequetequock section machine burners were used almost entirely except for the edges of the fields. About 70 acres of land were burned over in the town of Stonington, requiring 288 man days to complete the clean-up.

During the spring clean-up work, the United States Department of Agriculture paid for all the oil used and furnished all burning equipment. The State paid for all labor with the exception of the last week's work which was paid for by the Federal Government. All clean-up work was completed on April 21.

Plates XXII and XXIII show the burning apparatus and how it is operated.

Infestations of 1928

During the summer nearly the entire State was scouted for the European corn borer by scouts employed by the United States Department of Agriculture. Of the 169 towns in the State only 44 were not scouted and these were located in the center of the State. All the towns around the edge of the State were scouted with the exception of Kent in Litchfield County. A total of 30 towns were found infested, most of them in New London and Windham Counties.

The following towns were scouted and found to be infested with the European corn borer in 1928. Suffield in Hartford County; Clinton, East Haddam, Essex, Old Saybrook, Saybrook, and Westbrook in Middlesex County; Bozrah, Griswold, Ledyard, Lisbon, Montville, North Stonington, Norwich, Preston, Salem, and Voluntown in New London County; Canterbury, Killingly, Plainfield, Putnam, Scotland, Sterling, Thompson and Windham in Windham County; East Lyme, Groton, New London, Stonington, and Waterford in New London County were not scouted, but have been infested for several years, and it is safe to say that they are infested now.

The scouting showed that there was a large spread westward from Rhode Island of the double-brooded strain of the European corn borer. The general spread westward from infested towns in Massachusetts and New Hampshire was very slight as only one new town was added in Massachusetts and two in New Hampshire but the spread from Rhode Island into Connecticut was very great.

The eastward spread of the single-brooded strain in New York, western Massachusetts and Vermont was quite general and in some cases covered as much as 40 miles.

The town of Suffield in Hartford county was found infested by the one-brooded strain of the European corn borer apparently coming into the state from Massachusetts. The other infested towns are of the double-brooded strain. All towns along the Rhode Island boundary were found infested and in some cases several towns west of the State line were also infested.

It will be necessary to revise the present quarantine area before the next growing season.

REPORT OF SCOUTING AND QUARANTINE ENFORCEMENT FOR THE JAPANESE BEETLE AND ASIATIC BEETLE

J. Peter Johnson*

Japanese Beetle

During the summer season of 1927, Japanese beetles were found in New Canaan and Bridgeport. This caused an extension of the quarantine area eastward from Greenwich and Stamford, to include Darien, New Canaan, Wilton, Norwalk, Westport, Weston, Easton, Fairfield, Bridgeport, Trumbull, Stratford and Shelton. No further extensions were made and the area remained the same throughout the year of 1928.

The general procedure followed in carrying on the work was the same as that carried on during the past year. The infestations in Bridgeport and Stamford had increased considerably and beetles were found there more readily and in larger numbers. Only three beetles were found in New Canaan in the same location where one was found during 1927.

Below, a concise report is given of the work performed during the past year.

SCOUTING

On July 5, 1928, twenty-two men reported for scouting work, at the Shelton office. These men were divided into five field crews of four men each, and one greenhouse scouting crew of three men, one of whom reported earlier for training. The supervisor in charge of the field scouts, who had also reported earlier, took all the men to Bridgeport, where he and one of the permanent men gave them a schooling for ten or twelve days. Individual crews were assigned to their territories outside of the quarantined area, as their proficiency in scouting warranted.

*Mr. Johnson has had general charge of this work for the State of Connecticut and for the Federal Plant Quarantine and Control Administration. He has been authorized to employ and discharge men as needed for the benefit of the Service. For the most part, the scouts and patrolmen have been carried on the Federal payroll. [W.E.B.]

The State was divided into scouting areas, to be covered by crews assigned to them. These areas in a few cases overlapped, to enable another crew to assist, if necessary. The divisions were made according to the number and size of towns surrounding a given point, also upon the movement of traffic and the distribution of farm products. This enabled us to approximate the territory that could be covered by a crew or crews, during the entire season. In some cases one crew covered two or more areas; for example, the crew assigned to the Danbury area upon completion of the work was moved to Waterbury. It was necessary to place two crews in New Haven, in order to complete the area in good season.

Upon completion of the schooling, the crews were placed as follows: one in Danbury, two in New Haven, one in Meriden and one in Hartford. Some time after these crews were assigned, additional funds were available and two more crews of four men each were employed. One was assigned to New London and the other to Manchester. The procedure then followed was to the effect that the larger towns were first scouted and then all surrounding smaller towns in the vicinity. Changes in location were made as soon as that particular area was completed. This method enabled us to scout practically all towns of large size, with the exception of Putnam, Thompsonville and Norfolk.

The supervisor in charge of the field scouts, visited the crews daily, assigning and checking their work and aiding when possible. He was also in close contact with the office concerning all phases of the work.

The crew of three greenhouse scouts, including the foreman, scouted all classified concerns, within the quarantine area. A car was assigned to this crew and this enabled them to cover their area twice a week, meaning that each classified concern was scouted twice a week during the entire season.

Contact scouting for the purpose of keeping informed of the conditions of old infestations for the increase of numbers and possible spread, was performed in Bridgeport, Stamford and New Canaan. This was done by the farm products inspectors, when their work was slack, and by other members of the force when possible.

The area scouted during the season of 1928, included the following towns:

Ansonia, Bethel, Branford, Bridgeport, Bristol, Cheshire, Cromwell, Danbury, Danielson, Derby, Devon, East Hartford, East Haven, East Norwalk, Guilford, Hartford, Madison, Manchester, Meriden, Middletown, Milford, Milldale, Newtown, Norwalk, Norwich, New Britain, New Canaan, New Haven, New London, New Milford, Plainville, Plantsville, Ridgefield, Rockville, Sey-

mour, Southington, South Manchester, Stamford, Stonington, Stratford, Thomaston, Torrington, Wallingford, Waterbury, Watertown, West Haven, Westport, Westville, Willimantic, and Westerly, R. I.

The locations of Japanese beetles found outside of the quarantined area of 1928, were as follows:

NEW HAVEN

Address	Beetles found	Date found
Mapledale Section, Evergreen Cemetery	14	July 21, 1928
Mapledale Section, Evergreen Cemetery	4	July 23, 1928
260 Howard Avenue	1	July 24, 1928
Total	19	

HARTFORD

Address	Beetles found	Date found
38 Sumner Street	5	Aug. 4, 1928
29 Sumner Street	4	Aug. 4, 1928
32 Sumner Street	3	Aug. 4, 1928
Total	12	

NEW LONDON

Address	Beetles found	Date found
29 Brainard Street	11	Aug. 6, 1928
29 Brainard Street	11	Aug. 10, 1928
29 Brainard Street	2	Aug. 13, 1928
25 Brainard Street	1	Aug. 13, 1928
29 Brainard Street	2	Sept. 4, 1928
Total	27	

The total number of beetles found outside the generally infested area was 58.

In conjunction with the field scouting, there was a total of 52 classified establishments scouted. There were not any beetles found.

There were also 12 sand, soil and manure establishments scouted and no beetles found.

The first beetle was found July 5, while the last one was found on October 13, 1928.

There were seven crews of four men each, one crew of three men under the direction of a supervisor, employed in the scouting.

FARM PRODUCTS QUARANTINE

1. General Survey and Discussion.

Just prior to June 15, 1928, a platform, ten by thirty feet, with a roof to provide shelter, was erected at the foot of Wall Street,

Bridgeport, Conn., near the railroad tracks and the Bridgeport market, as a center for all farm products inspections in Bridgeport and the surrounding towns. Shortly after June 15, when the farm products quarantine went into effect, there were three inspectors assigned to it. It was open from 5:00 a. m. to 5:00 p. m. with the exception of Saturday afternoons and Sundays. The three inspectors began work at different hours and worked eight straight hours, eating their lunch at the platform. Two men reported at 5:00 a. m. leaving at 1:00 p. m. while the third inspector reported at 9:00 a. m. leaving at 5:00 p. m. This gave the service of three inspectors at the peak of the rush hour and left one man after 1:00 p. m. when things were slow.

Arrangements were made with a commission house in Norwalk and also one in Stamford at each of which an inspector was available during the morning. These inspectors took care of all farm products inspection from their respective areas and all individual requests for inspection were referred to them.

Inspection was also carried out from the Shelton office. As a man was always assigned to the office besides the clerk, the inspections were made promptly.

The assigning to these four inspection points certain parts of the area enabled inspections to be given rather efficiently. In the majority of cases people desiring inspection were referred to the inspectors within their area and in some cases inspections were made at the point of shipment when they could be made there more efficiently.

The farm products supervisor visited the points of inspection daily and assisted in inspection during busy hours. He also scouted farm territories to find whether or not beetles were present in the areas from which products were shipped directly from the farm to points outside the quarantined area.

In conjunction with the farm products inspection, we had eleven road inspectors and one supervisor. Three crews of two men each were on duty at the Milford-Stratford bridge, Devon, Conn., twenty-four hours a day, seven days a week, on the Boston Post Road. At the Shelton-Derby bridge on the road from Bridgeport to Waterbury, there were three crews of one man each on duty twenty-four hours, six days a week, excluding Sunday. One road inspector on a mortorcycle patroled the Bridgeport-Newtown road and the Bridgeport-Bethel road, both of which led to Danbury, while another inspector on a motorcycle patroled the Norwalk-Danbury road and the New Canaan-Danbury road.

The road patrol covered all main lines of traffic leading out of the quarantined area into Connecticut, while all other roads led into back country and were more or less impassable and were not subject to daily traffic.

The supervisor of the road patrol visited the crews daily and also checked them at night. He substituted for men when necessary for them to be off duty.

2. Number of men employed in connection with the inspection, and certification of fruit and vegetables, cut flowers and hay and straw.

Location	Administrative	Supervisor	Foremen	Inspectors	Total
Bridgeport	..	1	..	3	4
Norwalk	..	..	..	1	1
Stamford	..	..	..	1	1
Shelton	3	..	..	office	..
Total					6

3. Inspection points, number of packages certified, and number of beetles removed.

Place	Period operated	Hours per day open	Number of men	Packages certified	Beetles removed
Bridgeport	June 15–Oct. 1	12	4	110,125	6
Norwalk	June 15–Oct. 1	8	1	16,831½	1
Stamford	June 15–Oct. 1	8	1	4,490	6
Shelton	June 15–Oct. 1	8	..	27,513½	0
Total			6	158,960	13

4. There were 353 boxes of cut flowers certified for shipment outside of the quarantined area.

5. Total Certificates Used in State Regulated Area

Issued for	Total
Fruit and Vegetables	5,313
Cut flowers	353
Hay and straw	37
Total	5,703

6. Roads posted with quarantined signs in 1928.....33

There was a total of six roads patroled by eleven road inspectors working under one supervisor.

1. Number of vehicles bearing quarantined articles intercepted at the quarantine line, each month and the season total.

Month	Devon	Shelton	Stepney Bethel	Wilton Ridgefield	Total
June 16 to 30	601	270	66	39	976
July 1 to 31	1,160	741	216	100	2,217
Aug. 1 to 31	1,195	742	120	98	2,155
Sept. 1 to 30	692	175	...	...	867
Oct. 1 to 15	55	...	...	...	55
Total	3,703	1,928	402	237	6,270

2. Total number of men employed in connection with farm products at all offices (Inspection, certification and enforcement).

	Administrative	Supervisors	Foremen	Inspectors	Total
Inspection and certification	3	1	..	5	9
Road Patrol	..	1	..	11	12
Total	3	2	..	16	21

NURSERY AND ORNAMENTAL STOCK.

1. Japanese Beetle Quarantine Office in the State of Connecticut and area of jurisdiction under same.

SHELTON (State Headquarters) Hurley Building, Shelton, Connecticut
Townships in Fairfield County:

Bridgeport	Fairfield	Norwalk	Stratford	Westport
Darien	Greenwich	Shelton	Trumbull	Wilton
Easton	New Canaan	Stamford	Weston	

2. There were 58 Nursery and Greenhouse establishments having 1,203½ acres of stock and 473,380 sq. feet of glass, classified for making shipments out of the quarantined area.

3. During the year, 389,914 plants were certified for shipment outside of the quarantined area.

4. A total of 11,030 certificates were used in inspection and certifying plants for shipment.

5. There were 3,663 shipments reported to the 10 states requiring notice of them.

6. Four establishments dropped their classification for shipping out of the area because they found their business was confined within the quarantined limits, or else went out of business.

SAND, SOIL, EARTH, PEAT, COMPOST AND MANURE.

1. A total of 193½ car loads of sand and 60 car loads of manure were certified for shipment outside of the quarantined area.

2. Certificates, totaling 1,469 in all, were used in certifying sand and manure.

SUMMARY

1. Average number of men employed in each different branch of the quarantine work at each office, each month, during the year, 1928.

SHELTON OFFICE

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Scouting	0	0	0	0	0	2	25	29	5	0	0	0
Farm Products	0	0	0	0	0	17	21	16	9	1	0	0
Nursery and Greenhouse	0	2	2	2	2	2	2	2	2	3	3	3
Administrative	2	1	1	2	2	2	2	2	2	2	3	3
Total	3	3	3	4	4	23	50	49	18	6	6	6

2. Total number of each kind of certificates used on shipments of products listed below:

Farm Products	Cut Flowers	Hay and Straw	Nursery and Ornamental	Sand Soil	Peat etc.	Manure	Total
5,313	353	37	11,030	1,179	0	292	18,204

3. Total number of certificates lost or unaccounted for.....23

4. There were no state violations of Japanese beetle quarantine prosecuted during 1928.

REPORT OF ASIATIC BEETLE WORK, 1928

The quarantine enforcement and inspection has been in immediate charge of Mr. Benjamin W. McFarland.

The scouting for the Asiatic beetle, was carried on in conjunction with that of the Japanese beetle. No beetles were found outside of the quarantined area in Westville and none in West Haven, on or around the known infested area. Diggings made in West Haven in the spring showed only two lawns infested. The infestation was much less than when first discovered and was of such a nature that unless a man was stationed there throughout the scouting period, there would be only a slight chance of finding any adults.

The infestation as a whole in Westville, is stronger than that of the spring of 1926, when treatment and control work was started by the State. The control work was carried on during the spring and fall of 1926 and the spring of 1927, which resulted in a check of the degree of infestation. However, during the fall of 1927 and the year of 1928, because of the fact that no extensive control work was carried on, the infestation increased each year and the infestations gained considerably in population, while the lightly infested area assumed proportions which resulted in much lawn injury, which appeared this last fall. This condition existed mainly west of Edgewood Park. However, lawn injury appeared

in the Park rose garden and on a strip of lawn (part of the park system) on Edgewood Avenue between Brownell Street and the Boulevard.

Adults were readily found during the peak of the season in the heavily infested area. The first beetle was found, June 26, 1928, at 304 Yale Avenue, Westville, New Haven, Conn., while the last was found August 29, 1928. There was no record of the exact location at which the last beetle was found.

During 1927 and 1928, rather extensive control experiments were carried on by Dr. R. B. Friend, of this Station, with lead arsenate. The report of his work is published in Bulletin No. 304.

Altogether 55 requests were received during the year from individuals for investigations to determine whether or not their properties were infested and for information regarding control measures. These requests were fulfilled and in many cases control work was instigated.

The quarantined area was patrolled regularly throughout the year, warnings issued to all making excavations of any kind, and information given regarding the quarantine and regulations. In general, as in 1926 and 1927, hearty cooperation was received from those who found it necessary to operate under quarantine regulations.

There were 1,194 plants inspected for shipment during the entire year, and 4,368 package certificates were issued for other plants which were free to move under certificates without inspection.

Approximately 3,281 cubic yards of soil and sand were certified for shipment. The soil came from excavations made in the area and was taken two feet below the surface. The sand was shipped from a certified sand-bank. A total of 4,863 certificates was issued during the entire year.

THE PERIODICAL CICADA OR SEVENTEEN-YEAR LOCUST IN 1928.

Tibicina septemdecim Linn.

Brood No. II of the periodical cicada or Seventeen-year locust appeared in Connecticut in 1928 according to expectations. This insect has one of the strangest and most interesting of all insect life histories. It is also one of the most difficult to study and follow through to its end—a period of seventeen years. It appeared in Connecticut in June 1894, the first summer that the writer lived in Connecticut. No particular attempt was made in 1894 to gather distribution data, but specimens were collected in Branford by Dr. Wm. C. Sturgis, then Botanist of the Station. In 1911, the insect appeared in large numbers, and a fairly complete ac-

count was published in the Report of this Station for 1911, page 296. In 1911, the insect was reported from three counties and 21 towns, shown on the map (Fig. 62), as follows: Hartford County: Avon, Berlin, Farmington, New Britain, Plainville, Rocky Hill, Southington and West Hartford; Middlesex County: Cromwell, Durham, Killingworth, Middlefield and Middletown; New Haven County: Branford, Cheshire, East Haven, Guilford, Hamden, Meriden, New Haven, North Branford, North Haven and Wallingford.

Distribution in 1928

In 1928, this insect appeared in about the same localities as in 1911, though no attempt was made to obtain reports from all of the towns where it appeared in 1911. The members of the Department staff in traveling about the State in the course of their work brought in a number of observations.

The first notification of the appearance of this insect in the State in 1928, was received in a letter from Branford the first week in June. Messrs. Friend, Walden, Zappe and the writer visited the spot on the afternoon of June 5. The insects had begun to emerge along the sides of a road leading from Sagal-lou Farm to the head of Lake Saltonstall. There were no treees in the particular area though trees were not far distant. The adults and pupa shells were resting on grass, weeds and sumac sprouts, none of which were more than two feet tall. This area from which the insect emerged was probably not more than 100 feet long, and considerably less in width. Material was collected and brought to the laboratory.

On June 11, in response to a telephone call from Gaylord Farm Sanitarium in Wallingford, Dr. Friend, Mr. Turner and the writer visited the place in the afternoon. The manager feared that the insect might cause severe damage to the orchards. We found the adults and pupa shells rather common around the farm house and grounds, even on pine trees but could find none in the nearby apple orchard. Workmen reported that pupae were abundant underneath stones in an adjoining pasture a few days before. We therefore turned over hundreds of stones along the pasture fence and collected many pupae, showing that only a portion had emerged. On June 13, a telephone call from Gaylord Farm informed us that the cicadas were much more abundant on trees around the farm buildings than on the date of our visit, two days before.

On June 12, Messrs. Friend, Turner, and Walden visited Rocky Top ridge west of the Station Farm, in the town of Hamden, and collected some adults. The insects were making a great racket there but flew away into the trees when disturbed. A goodly number were collected and brought to the Station.

Some of the insects were found on the ridge north of Lake Wintergreen, on or near the farm of Mr. H. F. Baumgardt, but appeared to be much less abundant in this locality than in 1911.

County Agricultural Agent, Raymond K. Clapp, reported the insect as being present on his farm about two miles northeast of Ive's Corner in Cheshire, and also from C. O. Young's orchard in East Wallingford, and Frank Snow's orchard in North Branford.

On June 17, while driving for pleasure, the writer observed, heard, and collected adults on the road between Clintonville and

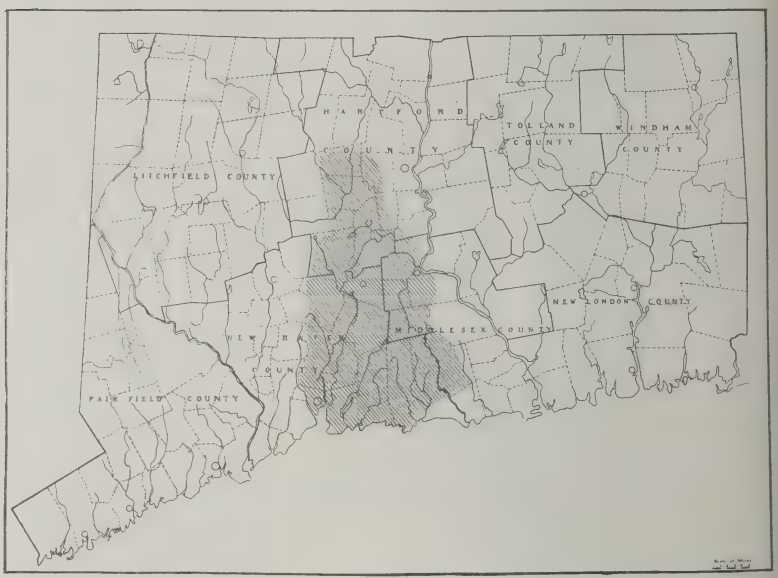

FIG. 62. Map of Connecticut showing area occupied by Brood II of the periodical cicada in 1911.

Northford, probably in the town of North Haven but near the North Branford line. They were making a great racket in a clump of oak trees on a hillside. He also heard them at two places in Guilford east of the Guilford-Durham State road.

Mr. Zappe heard or observed the insects, or afterwards saw the broken twigs caused by their egg-laying habits, on the ridge from Meriden West Peak, Hubbard Park, north to Kensington where considerable injury was caused in one apple orchard; also in Farmington, Southington, North Branford, Middletown, East Berlin, on Higby Mountain, and on the south side of Mount Carmel in Hamden.

Professor J. A. Manter, of the Connecticut Agricultural College, reports that he and Mr. A. F. Schulze saw the cicadas in large numbers in Berlin, New Britain and Southington. One of his students, Mr. C. J. Anderson, reported that he saw them in Haddam and Middletown.

Newspapers reported the periodical cicada as being present around New Britain and Middletown. Thus it is apparent that the insect in 1928 occurred in about the same area as in 1911, as shown in Fig. 62, but in some localities at least it was less abundant than in 1911.

From these locality records, it will be seen that the insect occurred chiefly along the trap-rock ridges in the southern central portion of the State, and all of these localities are in Hartford, Middlesex and New Haven Counties.

Habits and Life History

The females splinter the twigs of trees in depositing their eggs, usually on the under side of the lower branches, as shown on Plate XXV, b. About six or seven weeks after the eggs are laid, the young cicadas as they hatch, drop to the ground and work their way into it twelve to eighteen inches beneath the surface. For seventeen years they live in the ground, burrowing with their forelegs, and for food they suck the sap from small roots between one-eighth and one-fourth of an inch in diameter. During this time, the larvae molt four times, the fourth molt usually occurring about the tenth year. It is very difficult to follow their development and movements, yet this has been done in a few cases by the Bureau of Entomology. When the larvae become mature during the seventeenth year, they work their way toward the surface of the ground, often remaining for days under stones. During this time they are not quiescent, but are quite active and often descend into their burrows out of sight, if one turns over the stone and tries to catch them. When they finally emerge, they do so through circular holes, about three-eighths of an inch in diameter. Sometimes these holes are in hard, well-packed soil such as a walk or the side of a road, and are often close together. In some cases they build up a pyramid or cone two or three inches high around the hole, but none of these were observed in Connecticut in 1911 or 1928. On emerging from the ground, the insect crawls up the trunk of a tree or upon twigs, leaves, stems of weeds, or upon fences or buildings, and soon the skin splits lengthwise along the back and the adult cicada comes forth. At first it is greenish white with soft limp body and wings. It clings to the surface with wings hanging downward, and soon becomes firmer and darker and assumes its normal appearance. The period of emergence extends over about six weeks, and within a week or so after

emergence the adults have mated and the females have commenced to deposit eggs. The old shells remain on the trees or fences for a long time. Sometimes a hundred or more may be counted upon the trunk of a tree. One of these shells is shown in Fig 63, and others on Plate XXVI. As with other species of cicadas, the rattling noise or "song" is made only by the males which have curious diaphragms or drums at the base of the abdomen on the under side of the body. These organs vibrate rapidly, to make the rattling noise.

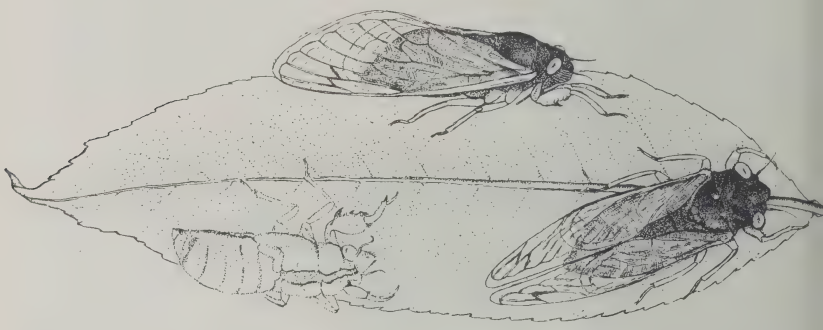

FIG. 63. Periodical cicada, adults and pupa shell on leaf. Natural size.

DESCRIPTION OF VARIOUS STAGES

Egg. About 2 mm. long, white or pale yellow, transparent, slender, curved and pointed at both ends.

Larva. Dirty white, light brown or yellowish color. A wingless grub, with forelegs modified for burrowing, and with sucking mouth; resembling pupa. More or less hairy.

Pupa. About one inch long, nearly three-eighths inch thick, light brown or tan in color, with prominent legs, the fore pair fitted for burrowing. Head and eyes prominent, antennæ relatively small and inconspicuous. Abdomen large. Thorax and abdomen smooth and shiny. Head and legs hairy.

Adult. Wingspread of about three inches. Body from one to one and one-fourth inches long, about three-eighths of an inch thick. Wings transparent, shiny. Costa bright orange-yellow, other veins fuscous shading to orange at base of wings. Margins and marginal cells more or less fuscous-shaded, the shading and venation at base of marginal cells forming a W near the apex of each forewing. Body dark brown or black above, waxy. Ventral surface of body and legs brown shading to orange. Eyes bright coral red in life, color mostly disappearing in death. Antennæ filamentous, inconspicuous, tapering, 6-jointed, black. The female has a sharp-pointed abdomen with a horny ovipositor folded

up on the ventral surface near the tip. The male has a larger and more blunt abdomen, with a pair of sound boxes or drums on the under side at the base, just back of the rear legs.

The appearance of the adults and pupal shells may be seen on Plates XXV, a, and XXVI, b, and in Figure 63.

Injury to Trees

The effect upon trees caused by hordes of immature cicadas sucking sap from the roots is not well known and consequently cannot be evaluated here. Probably it injures them, but the injury is usually considered as slight, or is disregarded altogether.

The adult cicadas rest upon the bark and leaves of trees, and the stems and leaves of succulent plants, and probably puncture the tissues and suck out a little of the sap, but this is not a serious injury. The chief injury is caused by the females which splinter the twigs with their ovipositors in depositing eggs, as shown on Plate XXV, b. Some of these twigs are weakened to such an extent, that they break off during storms or in a strong wind. The eggs are usually laid in longitudinal rows of punctures along the under side of the twigs of the preceding season's growth, having a diameter of from one-fourth to one-half an inch. Though some of these twigs break off completely and drop to the ground many of them hang and the leaves become dry and turn brown. Sometimes a wooded hillside presents a brown appearance in midsummer from the great number of broken twigs.

In case a young orchard is established on land from which cicadas emerged seventeen years before, or adjoints infested woodland, serious injury may result from the splintered and broken branches. The writer saw such injury to young peach trees in an orchard in Guilford in 1911. Some of the branches do not break and though the scars gradually heal over (see Plate XXVII, a), they are unusually prominent for several years and the branches will always be weaker than uninjured ones. A young orchard injured in this manner should be pruned heavily the following winter or spring in order to remove most of the injured wood and to promote a vigorous growth of new and stronger branches.

Natural Enemies

In Connecticut, no parasites have been recorded from the periodical cicada. The larvae of four species of Diptera or two-winged flies are known to feed upon cicada eggs in the United States. Four species of Hymenoptera or four-winged flies are known to parasitize the eggs, and certain mites feed upon them, but none of these egg-parasites have been observed in Connecticut.

The large digger wasp or cicada killer, *Sphecius speciosus* Dru., kills many cicadas. The adult wasp stings the cicada and carries it away to its subterranean nest to serve as food for the young wasps. The sting paralyzes the cicada but does not kill it, and the wasp lays an egg on the body of the cicada, upon which the young wasp larva feeds.

Probably birds are the most important natural enemies of the cicadas. Members of the Department staff have observed in several places, large numbers of cicada wings upon the ground where birds had devoured the bodies of the insects and discarded the wings. It is commonly recognized by Connecticut farmers that crows do not pull corn during those seasons when cicadas are abundant. Mr. A. W. Butler found 31 species of birds that fed upon the periodical cicada in Southeastern Indiana in 1885; the more important were English sparrow, robin, blackbird, catbird, flicker, red-headed woodpecker, towhee, crow, Baltimore and orchard orioles, and several species each of fly catchers and sparrows.

A fungus described in 1851 as *Massospora cicadina* by Peck, appears on the bodies as a greenish mold, and destroys many adult cicadas, especially males, in some parts of the country, but has not been observed in Connecticut.

Control Measures

In general, preventive or control measures are scarcely practicable against the periodical cicada. If the insect appeared each year in the same localities possibly something might be done, but it comes only once in seventeen years, and is usually forgotten before it comes again.

Small and choice trees may be protected from injury by covering them with mosquito netting.

Applications of insect powder or pyrethrum are fatal to the adults, and this remedy has been mentioned in publications dealing with this insect. It is usually recommended that it be dusted upon the newly emerged adults in the early morning when covered with dew. Dr. R. B. Friend, of this Department, on June 12 counted out 60 well-hardened adult cicadas, placed 20 in each of three cages, and sprayed two lots. One lot received nicotine sulphate (1-500) with soap added; the other lot received pyrethrum extract prepared after Van Leeuwen's formula* which gives oleoresin of pyrethrum at a concentration of about 1-800. The third lot or check was sprayed with water. After three days, four were dead in the check lot and 16 alive; all were dead in both the other cages. There is some evidence to show that trees sprayed with

*Jour. Econ. Ent., Vol. 19, pp. 786–790.

Bordeaux mixture, lime-sulphur, or whitewash are injured considerably less than untreated trees, and therefore such materials may be considered as partial repellents.

Literature

Britton, W. E., Report Conn. Agr. Expt. Station, 1911, page 296.
Marlatt, C. L., Bulletin No. 71, Bureau of Entomology, U. S. Dept. of Agr., 1907.

NOTES ON THE NEST BUILDING HABITS OF THE PIPE ORGAN WASP*

By Thomas B. Osborne

The nest consisting of three tubes cemented together is a part of one of originally five tubes, two of which were broken when removed from a partition in a stable at Washington, Conn., about August 22, 1916. This was fastened to a smooth board in a nearly vertical position with the opening downwards, as indicated in the drawing (Fig. 64, B). About three feet away another nest was being built. When first noticed, this was about one inch long, at 11 a. m. Two wasps were engaged in constructing this nest. One, smaller than the other, and apparently browner in color was inside;[1] the other, black with a blue lustre,[2] worked on the outside, collecting clay and putting each portion in place. The clay was brought moulded into a strip about three-fourths inch long and one-sixteenth inch in diameter. This strip, as near as I could see, was carried on the front leg and held by one end with the jaws. This end was applied to the crotch at the median line of the nest and then rapidly attached to the edge of the piece which had previously been put in place. Apparently it was moulded by the jaws and pressed into position until the end of the strip reached the end of the preceding portion and there came into contact with the board to which the nest was attached. The end was then flattened out against the board, the jaws and fore feet being used to make it adhere firmly. During this process, the wasp inside made a buzzing sound and seemed to be engaged in maintaining a

*During the summer of 1916, Dr. Osborne, head of the Department of Biochemistry of this Station, spent his vacation in Washington, Conn., and became interested in watching some mud wasps construct their nest on a board of the barn. On returning to New Haven he brought me one of the wasps, the nests, and the notes and said that I might use them in any way I saw fit. The wasp was identified by Dr. H. T. Fernald, Amherst, Mass., as *Trypoxylon albitarse* Fabr. (male). The nests were provisioned with spiders which were sent to Mr. J. H. Emerton, Boston, Mass., who reported as follows: "The spiders from wasps nest are all *Epeira trivittata* Keyserling, all females, and half of them adults. They make round webs and live in the tall grass and bushes all over the country". The illustrations on Plate XXVIII are from photographs by B. H. Walden; those shown in Fig. 64 were traced by Dr. Philip Garman from pencil sketches made by Dr. Osborne. Dr. Osborne died suddenly, January 29, 1929, and as these notes had not been published, it was thought best to include them here. [W. E. Britton.]

[1]This looked like Fig. 5, Plate II, *Pelopaeus cementarius*, ♀, Bull. 2, Wis. Geol. and Nat. Hist. Survey.

[2]Like Fig. 3, Plate II, *Chlorion coeruleum* ♀, *Ibid.*

proper sized bore for the tube under construction. When the clay was attached the larger wasp went inside the tube and the two set up a loud buzzing for a few seconds. It then came out and flew away to return after two or three minutes with another strip of clay which was put in place on the opposite edge of the opening of the nest. This process was continued. Each time the outside wasp returned it struck the wall about three or four feet from the nest, but located the nest after a few seconds by flying about on one side or the other, coming gradually nearer each time as

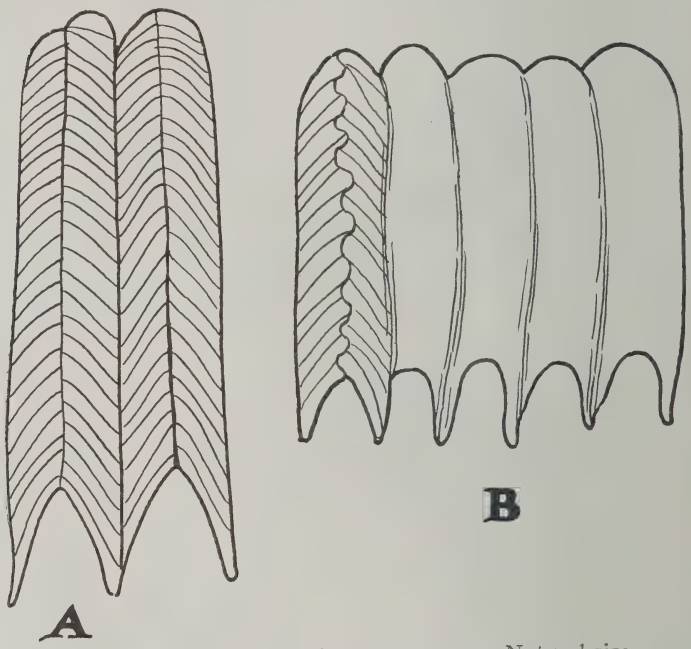

FIG. 64. Nests of the pipe organ wasp. Natural size.

though attracted to it by some invisible force. After every four or five trips by the outside wasp the inside wasp would come out and fly away. When it returned it struck the wall much further away than did the outside wasp and had more difficulty in finding the nest. Whether or not it brought anything with it I could not see. At any rate, whatever it carried was very small. On returning, this wasp went directly into the nest and stayed there until the outside wasp had put three or four more strips of clay in place. I did not see the first tube finished or the second tube begun for I had to go away when the former was about two inches long. About 9 a. m. the next morning the first tube was approxi-

mately three inches long and a second tube had been made which was about one and a half inches long when I first saw it. I watched the construction of the second tube until 11 a. m. when it was as long as the first. When it reached this length the inside wasp set up a very loud buzzing when the outside wasp came back with more clay and apparently made such a fuss that it did not dare attempt to put the clay in place. After attempting several times to do so the outside wasp flew off with the clay and came back again, after a few minutes, apparently without any clay and went inside the nest. It then made regular trips coming back with such small quantities of clay that I was unable to see that it carried anything. When it entered the nest, clay must have been brought because after several trips a partition had been built across the lower end of the tube. I did not see any spiders put into the tube before the partition was completed, but I did not watch them continuously and this may have been done while I was away or it may have been done during the trips of the inside wasp, but I think I would have seen the spiders when it came back to the nest if it brought any. A heavy thunder shower put an end to the work for the day. The next day, no more work seemed to be done and the outside wasp was not seen. One, or both, were in the nest in the afternoon as evidenced by the buzzing which followed on putting a straw into the tube. The tube first made had a partition about one-half inch from its mouth. It probably had two others lower down. Both tubes were attached to the wall in a vertical position with the mouth opening downwards. (Fig. 64, A, and Plate XXVIII).

MOSQUITO CONTROL WORK IN CONNECTICUT IN 1928

R. C. Botsford

Mosquito control work during the season of 1928 consisted largely of supervising the treatment of mosquito breeding areas, and was concerned especially with the ditching of salt marshes. Inasmuch as this season was the greatest for the treatment of new areas since 1916, it seems best to describe in some detail the method of procedure and the part this Station plays in the average mosquito control program undertaken by a community or individual.

Procedure of Mosquito Control Work

Chapter 68 of the Public Acts of 1923 authorizes the Director of the Connecticut Agricultural Experiment Station to investigate the places where mosquitoes breed and to order these areas treated as required to eliminate mosquito breeding therein. Investigation, or a brief survey, to determine the extent of the area to be treated

and the cost of treatment may be made upon request and for this work there is no charge by this Station. But sufficient funds must be provided to complete the treatment according to the survey before the legal order and notice is issued. This order and notice contains a brief description of the plan to be followed and is delivered to record land owners affected to notify them of the proposed work and a copy placed on file with the local town clerk, and also published in a newspaper of local circulation.

Funds for treating the area in question are usually provided from town funds or are contributed by local residents, associations or corporations. The project of mosquito elimination in any community is, as a rule initiated by one or more influential and public-spirited individuals who can give some of their time to a rather educational campaign concerning the absence of mosquito nuisance in relation to real estate values, the improvement or reclamation of swampy land, the raising of sanitary standards, the reduction of malaria cases, and the most effective reason of all—personal comfort out-of-doors and in.

The individual interested usually introduces a motion before the local town meeting requesting town funds for the work, or a house-to-house canvass can be made. Usually a combination of town appropriation and personal subscriptions is very satisfactory. State funds are not available at this time to aid in the labor cost of this work, but a limited amount of time may be given by this Station to aid in making a preliminary survey in supervising the field work and inspecting the work as it progresses.

When sufficient funds are available and it is desirable that this Station supervise the work, it is customary to send the funds to the Station for deposit with the State Treasurer. As the work proceeds, these funds are drawn as required by certified vouchers, and the contractor is paid only for work which merits our approval. Men experienced in mosquito control work and reliable contractors capable of treating large areas effectively are not easily obtained, and unless the work is properly supervised, large sums of money may be expended without obtaining the desired results and when this occurs future mosquito control projects in other communities may become more difficult to develop.

Wherever any land has been drained to the approval of the Director of the Connecticut Agricultural Experiment Station, the drainage works shall be kept in repair at State expense. To carry on this maintenance work, this Station is dependent upon what the General Assembly sees fit to appropriate for that purpose. For the past six years, funds have been so insufficient that some of the work has deteriorated and returned to a mosquito breeding condition and large areas recently ditched and approved could not be accepted for maintenance due to lack of funds. The inadequate funds available for maintenance cannot be prorated effectively over these large added areas of newly ditched salt marsh be-

cause a larger proportion of money would be expended for transportation and much less would be left per acre of salt marsh. Funds which would be sufficient to keep certain contiguous areas in non-breeding condition would be split up if expended over widely separated areas, thus increasing the transportation cost and cutting down the labor per acre. This would necessarily result in allowing small breeding places to exist on all areas, thus leaving all the work incomplete and consequently ineffective. Proper maintenance of ditched or otherwise treated areas is one of the most important phases of mosquito control. Trained men are necessary to keep the work in proper condition. This is especially true in regard to crew foremen who must be intimately acquainted with all the characteristics of the areas under their supervision and know the shortest routes to and from the areas. Several seasons of experience are necessary training for this work and men of this type should be available each season, which makes it necessary in some cases to pay these men through the winter months when no work can be done, in order to have them on hand for the spring work. The table below shows the area in acres of salt marsh under State maintenance in 1928-1929 and all ditched areas which could come under State maintenance in 1929-30 if funds were provided. It also shows the plan necessary for proper patrol and maintenance.

NEW PLAN FOR MAINTENANCE

Town	No. Acres 1927–1928	No. Acres 1929–1930		
WESTERN DISTRICT				
Stamford	200	300	2,500 acres	1 foreman..$1,330
Norwalk	....	600		2 laborers... 1,440
Westport	....	400		
Fairfield	1,200	1,200		
NEW HAVEN DISTRICT				
West Haven	222	222	3,959 acres	1 foreman..$1,330
New Haven	675	750		4 laborers... 2,880
Hamden	....	520		
East Haven	50	482		
Branford	578	900		
Guilford	1,085	1,085		
EASTERN DISTRICT				
Madison	1,005	1,005	3,405 acres	1 foreman..$1,330
Clinton	....	800		3 laborers... 2,160
Westbrook	....	500		
Old Saybrook	....	300		
Old Lyme	....	450		
East Lyme	....	300		
Groton	50	50		
Total	5,065	9,864	Total cost—Labor only for 1 year.	$10,470

NEW WORK

Town	Approx. No. acres ditched	Linear feet of ditches	Cost	Day Labor	Legal Expense	Total Expenditure
Norwalk	500	14,164	$354.10	$2,860.60	.....	$3,214.70
New Haven	....	.....	.....	.....	$18.40	18.40
North Haven	....	.....	.....	.....	20.26	20.26
Hamden	250	98,332	2,461.31	121.35	18.58	2,601.24
East Haven	300	100,322	2,509.20	1,215.96	22.36	3,747.52
Branford	317	113,192	2,837.79	352.02	21.98	3,211.79
Madison	100	31,273	781.83	940.80	.....	1,622.63
Westbrook	80	34,088	852.21	.....	.....	852.21
Saybrook	86	39,943	998.59	.....	.....	998.59
Old Lyme	300	128,330	3,228.25	103.04	11.48	3,342.77
East Lyme	130	58,423	1,461.48	1,201.89*	19.12	2,682.49
	2,063	618,067	$15,484.76	$6,795.66	$132.18	$22,312.60

WORK OF THE SEASON

The summer of 1928 was a mosquito year, as was also the two preceding seasons. Mosquitoes were very abundant in some localities, in fact, so aggravating that in some of the most conservative townships the electors in open town meetings made generous appropriations for ditching their salt marshes. In 1928, nine towns made appropriations totaling over $25,000 and individuals contributed $7,000 more, making a total of $32,000. (Total of ditches installed 618,067 feet.) The majority of towns turned their funds over to this Station, but some preferred to pay the contractor direct. All details of the work were managed by this Station. The ditching was done in a lump contract and was awarded to John F. Ross, 1660 Putnam Avenue, Ridgewood, N. Y., at two and a half cents per linear foot. Mr. Ross spent practically all of his time on the salt marshes and no important details were overlooked to make the work as perfect as possible. The Deputy in charge inspected the work as it progressed and a high quality of work was maintained. In reviewing the work separately by towns, it is necessary to be as brief as possible and to refer the reader to the tabulation of statistics for details as to acreage, cost, future expenditure and so forth.

WORK DONE UNDER NEW HAVEN CHAMBER OF COMMERCE PLAN

Source of Funds	Resident Contributions	Town Contributions	New Haven Quota		Total	Expended	Balance
Hamden	$1,515.00	$2,500.00	$1,272.48	32%	$5,287.48	$2,601.24	$2,686.24
North Haven	15.00	.....	676.01	17%	691.01	20.26	670.75
Branford	321.00	2,500.00	717.77	18%	3,538.77	3,211.79	326.98
East Haven	35.50	2,500.00	1,113.42	28%	3,648.92	3,747.52	−98.60
New Haven	3,976.51†	750.00	198.83	5%	948.83	18.40	930.43
C. of C.	.....	.....	.....	....	300.00	.....	.....

*Fresh water swamp.

†This amount, $3,976.51, including $300.00 contributed by the New Haven Chamber of Commerce, was prorated to all towns according to acreage of area to be treated.

The Work by Towns

NEW HAVEN

As a result of its recent campaign, the New Haven Chamber of Commerce collected $21,232.00 to be used for relieving the City of New Haven from mosquitoes migrating from unditched salt marsh areas in Hamden, North Haven, East Haven and Branford, and for ditching a small area near Morris Cove.

Of this amount $6,000.00 was appropriated by the City of New Haven for straightening and dredging Morris Creek, and in addition the Public Works Department from its own funds built a tide-gate in Little River at Middletown Avenue.

The total publicity expenses, consisting chiefly of printing and distributing printed matter, was deducted from the contribution of New Haven residents, leaving a balance of $3,976.51 to be donated to Hamden, North Haven, East Haven, Branford, and New Haven on an acreage pro rata basis as shown in column four in table. Hamden receiving 32 per cent, North Haven 17 per cent, East Haven 28 per cent, Branford 18 per cent, and New Haven 5 per cent. All funds originating within each of the four surrounding towns were to be expended within their own borders, plus the quotas mentioned above. This Station cooperated with the New Haven Chamber of Commerce throughout its campaign and supervised the ditching work. No new ditching was done in New Haven as it was necessary that the dredging of Morris Creek be completed first.

WEST HAVEN

The town of West Haven aided in maintaining the ditched areas. These areas were reported free from mosquito breeding the entire season. The work was under the supervision of Dr. Charles D. Phelps.

NORTH HAVEN

The town of North Haven failed to furnish funds and the New Haven quota was insufficient to start the work. (See table.)

The City of New Haven constructed a tide-gate on Little River which will protect the North Haven area from flooding by high tides and will facilitate ditching when the time comes.

HAMDEN

The town of Hamden contains 571 acres of salt marsh and is one of the new towns in mosquito control work. The work started near the New Haven town line and continued northward until funds were exhausted. About one-half the area was completed.

The town appropriation of $2,500 will become available for work in 1929. (See table.)

EAST HAVEN

The town of East Haven contains about 545 acres of salt marsh, of which but 50 acres are maintained by State funds. Under the New Haven Chamber of Commerce plan, about 300 acres were ditched this season at the cost of $3,747.52. (See table.) The areas yet to be ditched include the northwest corner of the marsh lying east of Hemingway Avenue, the long narrow marsh from Morris Creek to Hemingway Avenue, and areas near Morris Creek. All shore areas from the East Haven River to Morris Creek are completed. Funds are exhausted and about $1,300 will be required to complete the ditching in East Haven.

The town of East Haven dredged the upper part of Morris Creek, known as Tuttle Brook from the New Haven line north to Main Street. The town also installed a permanent beach outlet at Silver Sands to take the place of a pipe line 1,200 feet long which failed to drain a low area each side of Cosey Beach Avenue. These two improvements are of great importance not only from a mosquito control standpoint but as a sanitary measure as well.

BRANFORD

All salt marshes in the town have now been ditched. The cost of completing this work was $3,211.79 and covered the unditched area west of the Branford River to the East Haven town line. Final inspection only is necessary for State approval. (See table.)

The area east of the Branford River ditched in 1916 was patrolled and the ditches kept open with the exception of the diked Stony Creek marsh which requires reditching. The tide-gate at this location requires extensive repairs.

The construction of the tide-gates on the Branford River at Hubbard's Bridge should be completed. A new permanent concrete sill was installed at the 28 foot opening at considerable expense in 1927 and now new wing walls and new gates are required to make the unit complete.

GUILFORD

All ditches recently recut were patrolled and cleaned and the work of recutting continued. It is estimated that by the fall of 1929 all recutting should be completed and salt marshes in nonbreeding condition. The broken dike at Great Harbor was repaired by the property owners and is now in good condition, although the beach is cutting back in another location dangerously close to the dike.

MADISON

Reditching of the salt marsh areas in Hammonasset Park was completed this season at a total cost of $5,554.64. These funds were contributed by the State Park and Forest Commission and eliminated some of the worst breeding places in the town. The large area at Hogshead Point near East River should be reditched as soon as possible.

Corrugated iron pipes installed as beach outlets were somewhat damaged by storms but continue to function.

WESTBROOK

Ditching in the town of Westbrook was completed and sufficient funds remain to overhaul and clean the ditches in the spring of 1929.

OLD SAYBROOK

The town of Old Saybrook at its 1927 town meeting appropriated $1,000 which was expended ditching about 86 acres to the rear of Plum Bank. Another $1,000 was appropriated in 1928 to extend the ditching in 1929. The salt marsh areas recently ditched near Knollwood Beach by Simpson and Cosulich should be patrolled and ditches cleaned where necessary. The area at Fenwick ditched in 1916 should be entirely reditched.

OLD LYME

The town of Old Lyme at its fall town meeting appropriated $5,000 to start ditching its salt marshes. Some funds were made available immediately and ditching was started in the Black Hall section as this was considered the source of the greatest number of mosquitoes.

The marshes on the Black Hall River and at Smith's Neck were ditched and the work well started on Great Island when cold weather put a stop to the work. Total footage of ditches installed to January 16 is 128, 330 feet.

EAST LYME

The summer residents of Black Point in the town of East Lyme raised $3,000 for mosquito elimination in that vicinity. This amount was estimated sufficient in a recent survey by this Station to drain two fresh water swamps and a nearby salt marsh.

In the large brushy swamp on the top of the ridge, a ditch was dug extending from the roadway at the south end of the point northward to a small pond. It may be necessary to dig some spur ditches to distant depressions to make the drainage of the entire

area complete. A narrow fresh water swamp on the west side was ditched and drained by installing a corrugated iron pipe through the beach. The salt marsh west of the Point was ditched to a point a short distance above the wood road bridge (see table).

GROTON

Ditches were cleaned and graded where required and some new spur ditches installed. It is difficult to arrange more than one or two visits to this area a season, due to the distance from the nearest ditched area.

FAIRFIELD

The town of Fairfield cooperated as usual with the State and has aided this Station by supplying men and funds to keep the salt marshes in non-breeding condition. The draining of fresh water swamps continues to expand and has resulted in increased valuation of much property in addition to removing the source of disease-bearing mosquitoes.

WESTPORT

Ditching in the town was inspected and approved by this Station in 1927 but we could not maintain the work due to lack of State funds. The town of Westport however appropriated sufficient funds and employed Nicholas Matiuck to furnish labor and supervise the work. The ditches were patrolled and kept clean and areas requiring oil were sprayed with old crankcase oil as required.

NORWALK

For several seasons past the City of Norwalk has been infested with mosquitoes. At the request of Dr. Purdue, Health Officer, a preliminary inspection was made of the salt marshes and fresh water places. Prolific mosquito breeding was occurring in stagnant pools near the center of the city and immediate oiling was recommended to be followed later by filling or draining. The salt marshes were ditched in 1912 and were in fair condition. This Station recommended thorough reditching to put the work into condition which would pass State inspection. The City of Norwalk appropriated $4,000 for this purpose, of which $3,214.70 was expended this season. The ditching was approved on October 18, 1928.

STAMFORD

The city of Stamford for several years past has appropriated funds for mosquito control work. Some of these funds have been

added to State funds and expended under State supervision in maintaining the salt marsh ditches, and the balance for oiling fresh water swamps.

STATUS OF CONNECTICUT SALT MARSH AREAS, 1928

Town	Salt Marsh Areas	Salt Marsh Ditched	Maintained by State	Total Cost of Ditching	Labor, Cost Maintenance, 1928	Labor, Cost to Complete Ditching
Greenwich	200	200	none	$22,000.00	.....	.....
Stamford	300	300	200	3,245.80	$107.92	.....
Darien	300	300	none	3,800.00	.....	.....
Norwalk	600	600	none	7,500.00	.....	.....
Westport	400	400	none	5,913.82	.....	.....
Fairfield	1,200	1,200	1,200	8,400.00	509.83	.....
Bridgeport	173	....	....	.....	.....	$3,000.00
Stratford	1,315	....	....	.....	.....	20,000.00
Milford	630	....	....	.....	.....	9,500.00
West Haven	463	222	222	*	83.55	3,500.00
New Haven	750	750	675	12,000.00	310.50	750.00
Hamden	571	250	none	2,601.24	.....	2,500.00
North Haven	310	....	....	.....	.....	3,100.00
East Haven	545	300	50	3,747.52	.....	1,300.00
Branford	895	895	578	.....	417.12	.....
Guilford	1,085	1,085	1,085	20,000.00	789.57	.....
Madison	1,005	1,005	1,005	.....	1,777.03†	.....
Clinton	785	677	none	10,000.00	.....	2,000.00
Westbrook	500	500	none	7,428.14	.....	.....
Old Saybrook	1,373	186	none	2,000.00	.....	15,000.00
Lyme	493	....	....	.....	.....	7,500.00
Old Lyme	1,393	300	none	3,342.77	.....	15,000.00
East Lyme	424	130	none	1,480.60	.....	4,000.00
Waterford	204	....	....	.....	.....	3,500.00
New London	34	....	....	.....	.....	500.00
Groton	304	50	50	1,000.00	15.00	4,000.00
Stonington	555	....	....	.....	.....	8,500.00
Totals	16,807	9,350	5,065	$114,459.89	$4,010.52	$103,650.00

*Ditched with New Haven.
†State Park and Forest Commission $1,622.63.

MISCELLANEOUS INSECT NOTES

Larch Sawfly: On July 30, Dr. R. B. Friend visited the Whittemore estate in Middlebury where many European larch trees had been stripped by the larch sawfly, *Nematus erichsoni* Hartig. The larvae had left the foliage and made their cocoons. An outbreak of this insect occurred in 1915, and a full illustrated account may be found in the Station Report for 1915, page 125. Spraying with lead arsenate will prevent defoliation. [W. E. Britton]

Spruce Epizeuxis Injures Blue Spruce: On July 2, 1928, several larvae and pupae of *Epizeuxis aemula* Hubner were collected on some blue spruce trees (Picea pungens) at Woodmont. Several adult moths were reared in the insectary from this material, emerging July 6 and 7. The larvae live mainly on the older needles back from the tips, and their webs and excrement, together with the dead needles, form a dense mat, as shown on Plate XXIX, a and b. A spray of lead arsenate would doubtless prove effective. [R. B. Friend]

The Horse Radish Flea Beetle on Cabbage: Adults of the horse radish flea beetle, *Phyllotreta armoraciae* Koch, were found attacking the leaves of young cabbage plants early in May, on the farm of F. E. Peckham at Norwich. When the plants were examined, most of the insects were on the under side of the leaves lying on or close to the surface of the ground, or in the axils of the leaves. The owner dusted the entire plot with lead arsenate and lime, one part of the former to four parts of the latter by weight, and the number of insects was materially reduced, although no exact experimental data were available. Prior to the planting of cabbage in the spring of 1928, horse radish had been growing on the land for several years. [R. B. Friend]

Say's Blister Beetle Injuring Peach Trees: On June 19, specimens of Say's blister beetle, *Pomphopaea sayi* Fabr., were received from Canaan, together with peach leaves which had been partially eaten by them. The correspondent reported that three young peach trees were covered with the beetles which were rapidly devouring the foliage. Three adult beetles were received. They were nearly three-fourths of an inch long, with head, thorax, and wing-covers dull green, legs honey-yellow, tarsi, knees and antennae, black. This beetle is rather rare in Connecticut and this is the first record of injury caused by it. Of course spraying with lead arsenate is the remedy. The beetle and injured peach foliage is shown on Plate XXIX, c and d. [W. E. Britton]

Weevil on Red Pine: The last of November, 1928, Mr. W. O. Filley, Station Forester, brought in some dead young red pines each of which contained several larvae of *Pissodes approximatus*

Hopkins, in the base of the trunk. The larvae were fully grown and in cells in the wood close to the bark. Adults were reared, emerging in the laboratory insectary January 18, 1929. The trees were about six years old and were part of a plantation in Goshen belonging to the American Brass Company. The infestation was confined to a small group of trees in a swale, and no signs of weevil injury were observed in the neighboring parts of the plantation. Several apparently healthy trees growing among those infested were examined and no indications of the presence of larvae could be seen. All infested trees were dead. This weevil very closely resembles the white pine weevil (*Pissodes strobi* Peck) in appearance. [R. B. Friend]

Abundance of Whiteflies: The mulberry whitefly, *Tetraleurodes mori* Quaintance, or probably its variety *maculata* Morrill, was extremely abundant on native and introduced trees and shrubs in 1928. This insect was observed in many nurseries and the flowering dogwood trees on the writer's premises were quite heavily infested. The air was literally full of flying adults the first half of September. Linden is a preferred host and a thoroughly infested leaf is shown on Plate XXX. On September 9 the writer observed thousands of pupa shells on the leaves of mountain laurel growing in woodland in Bethany. Most of them were clustered along the mid-vein on the under side of the leaves. As the adults had emerged, none could be obtained for identification, but the empty shells bore the characteristics of *mori:* past observations indicate that the variety *maculata* is the more common form in Connecticut. [W. E. Britton]

Carrion Flies Killed by Fungus: During the summer of 1928 the writer was impressed by the great number of metallic green or blue flies found dead and adhering to the leaves and stems of garden plants. Every gladiolus leaf had one or more and other plants bore them also. These flies were killed by a fungus, and were common not only in New Haven, but also in surrounding towns. Mr. E. M. Stoddard, of the Botany Department reported them as being abundant in his own garden in Whitneyville. On July 25, the writer visited a garden at 228 Sherman Avenue, New Haven, where in the rear yard a medium sized magnolia tree had dead flies attached to the outer margins of all the lower leaves, as shown on Plate XXXI. Dr. Friend examined the flies and found that most of them were *Lucilia sericata* Meigen, with an occasional specimen of *L. sylvarum* Linn., and *L. caesar* Linn. These flies breed in waste and decaying animal matter and it is difficult to explain why they were so much more abundant in 1928 than in other seasons. The fungus was identified by Dr. A. A. Dunlap of the Botany Department of Yale University, as *Empusa muscae* Cohn. [W. E. Britton]

Canker Worms in 1928: The fall canker worm, *Alsophila pometaria* Harr., usually causes more or less local damage in certain sections of the State each year. The defoliation of a large area in East Lyme in 1927 was recorded in the Report of this Station for 1927, page 261. During 1928, the damage in this section was less severe, but the infestation extended over a much larger area. In Hamden where canker worms have been abundant for at least two years, there was much less injury during the past season. The largest infestation observed in 1928 occurred from Madison through Clinton, Westbrook and Essex to the Connecticut River and covered several hundred acres. About fifty acres of woodland between Clinton and Westbrook were examined on June 22. The trees were largely oak, maple and birch and were nearly stripped. Practically the only foliage that was left were the mid ribs and larger veins of the leaves. The larvae were about full grown and were spinning down from the trees and attacking the undergrowth. The photograph on Plate XXVII, b, shows the appearance of the trees on June 22. From the highway a wooded side hill to the east for a distance of a mile or more appeared to be in a similar condition. Unsprayed fruit trees throughout the section appeared as though they had been scorched by fire. [B. H. Walden]

Thrips Attacking Cauliflower: On September 14, a report was received that a large field of cauliflower, belonging to a market gardener in Southington, was badly infested with thrips and a visit was made to the place the same day. In one field of about thirty acres, the plants, instead of forming heads were turning yellow and appeared to be dying. There were many thrips on the leaves, which showed the characteristic work of this insect. Most of the individuals were wingless. The plants were also badly infested with stem rot. Owing to these two troubles it was evident that the plants had been checked to such an extent that they could not be saved by any treatment. The owner had another field of about twenty-five acres of younger plants which appeared to be in a thrifty condition. Though the leaves did not as yet show any serious injury, there appeared to be enough young thrips present to eventually stunt the plants. As the owner had a power duster for dusting field crops, it was recommended that he give these young plants an application of nicotine dust. The thrips, upon examination, proved to be the onion thrips, *Thrips tabaci* Linde. Although this species has been known to attack a number of different kinds of plants besides onions, this is the first record of its attacking and injuring cauliflower in Connecticut. It has, however, been reported as infesting cauliflower seed beds in New York. [B. H. Walden]

The Common Red Spider: The common red spider, *Tetranychus bimaculatus* Harvey (*T. telarius* of many authors), is one of the

most serious pests of plants in greenhouses, and sometimes of garden plants. It frequently develops on plants forced inside and continues to breed after removal to the flower beds outside. Phlox is frequently attacked, damage being most severe in outside plantings in August or September, usually in dry weather. The complete life history has been studied under greenhouse conditions, and it seems probable that life history in mid summer is approximately the same. It is stated frequently in literature, and it is known to occur under some conditions, that the adult mite winters over, not the egg as with other species. The life periods are very short, and development rapid. Vinal states that the total cycle is seven to eight days while the adults live about two weeks, the females depositing 50-60 eggs. This mite and phlox leaves injured by it are shown on Plate XXXVI.

Various means of control may be employed. If the plants are conveniently located, frequent syringing with a fine spray from the garden hose is effective. In other situations, the plants may be sprayed with linseed oil emulsion, white oil emulsion, such as Volck, or dusted with very fine sulphur dust. Liver of sulphur (Potassium sulphide) is sometimes recommended for control of leaf spots, and should no doubt prove of some benefit in controlling the red spider since it deposits, on drying, a very fine sulphur dust on the surface of the leaves. Frequent applications of pyrethrum soaps such as Red Arrow[1] also appear to be effective and non-injurious. The latter treatment is probably safest provided a neutral soap is used but is also the most expensive of the sprays. Syringing with clear water is of course cheapest, but requires frequent repetition to be most effective. White oil emulsions are probably most effective, but are not as safe and recommendation of the manufacturers should therefore be followed closely. [Philip Garman]

A New Greenhouse Pest: During October, 1928 our attention was called to injury to greenhouse plants from a species of Tarsonemus apparently new to this district. This species, determined by Dr. Ewing of the U. S. National Museum by comparison with types, is identical with *Tarsonemus latus* Banks, although differing somewhat from his description. As observed, the species seems to be more active than *pallidus* which it resembles in general form, though being more robust. The fourth pair of legs of the male (Fig. 65) are entirely different from those of *pallidus*, as well as the first pair of legs of the female and the pseudostigmatic organs which are comparatively short and inconspicuouus.

The type of injury is the same as that caused by *pallidus* and consists of a scorched epidermis, sometimes shiny in appearance if compared with the dull surface of unaffected plants. The leaves later begin to curl and young plants may be stunted. The principal

[1]Should be used stronger than the manufacturers recommend, for satisfactory results.

injury thus far observed has been to tomatoes and tobacco plants grown for experimental use in one of our houses. It is a tropical species reported from the Virgin Islands, Florida, and greenhouses in Washington, D. C., and has been previously reported to infest peppers, lemons, citrons and mangos.

The possibility of damage to greenhouse plants from this pest is probably as great as that caused by the cyclamen mite, but the host plants will, of course, be different. Because of its similarity of habits and form it should be controlled by the same measures that control *pallidus:* namely, frequent applications of nicotine

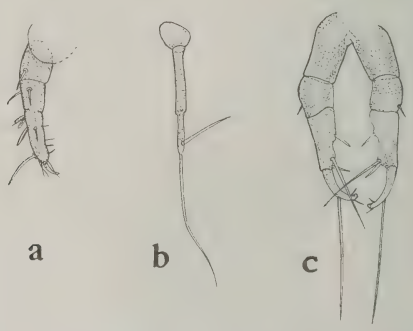

FIG. 65. Structure of *Tarsonemus latus* Banks. a, leg I of female; b, leg IV of female; c, hind legs of male.

sulphate, or naphthalene fumigation as described by Whitcomb and Hartzell. Moznette controlled it in Florida with sulphur dusts.

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[PHILIP GARMAN.]

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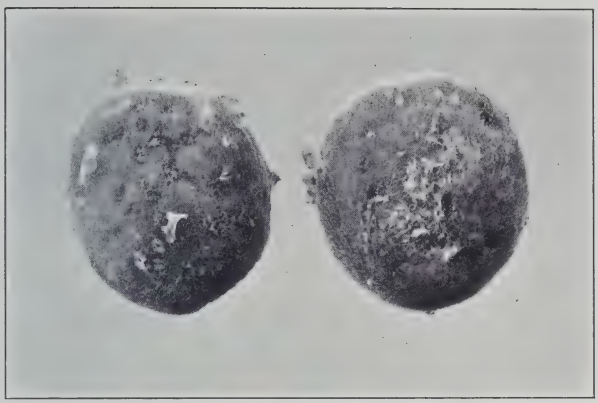
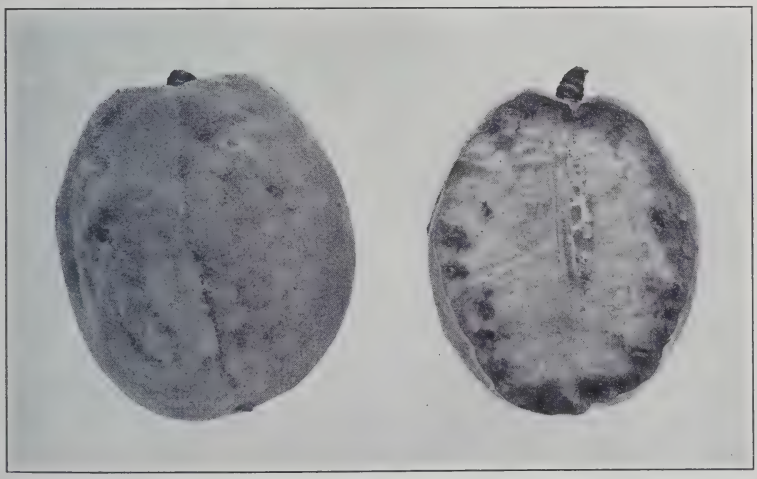


a. Peaches injured by oak plant bugs, natural size.



b. Section of peach showing injury by oak plant bugs, natural size.

WORK OF OAK PLANT BUGS.

a. View of burning apparatus.

b. Another view of same apparatus.

CORN BORER WORK.

a. View showing corn field with burner in operation.

b. Female, male, larva, pupa and burrow in cornstalk. Slightly enlarged.

EUROPEAN CORN BORER.

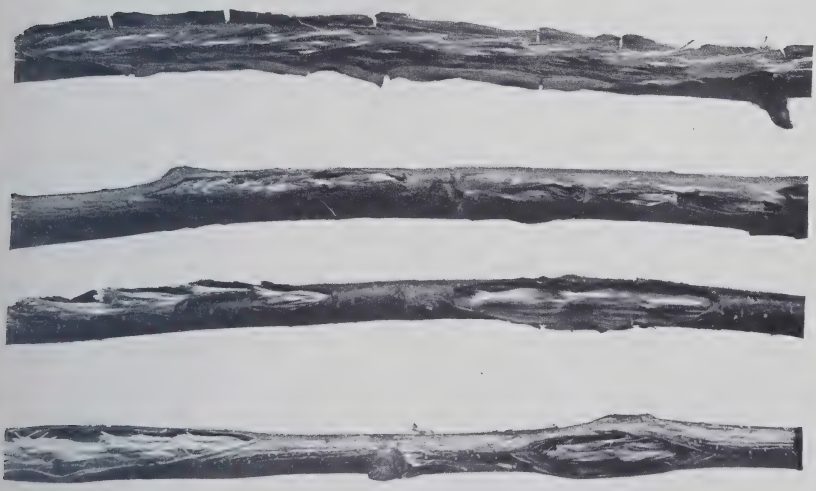
a. Japanese beetle, *Popillia japonica* Newm.; adults twice enlarged.

b. Apples injured by Japanese beetles (After Jap. Beetle Lab. U. S. Dept. of Agriculture).

c. Japanese beetles clustered on fruit (After Jap. Beetle Lab., U. S. Dept. of Agriculture).

JAPANESE BEETLE.

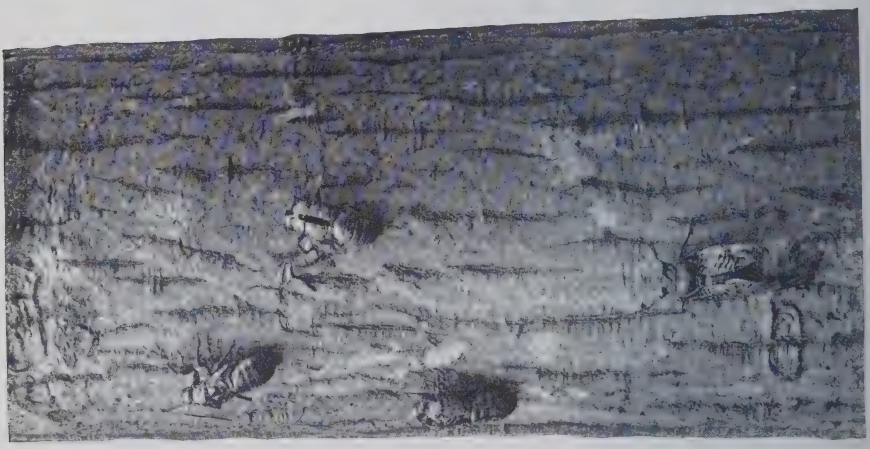
a. Males (below) and females (above). Natural size.

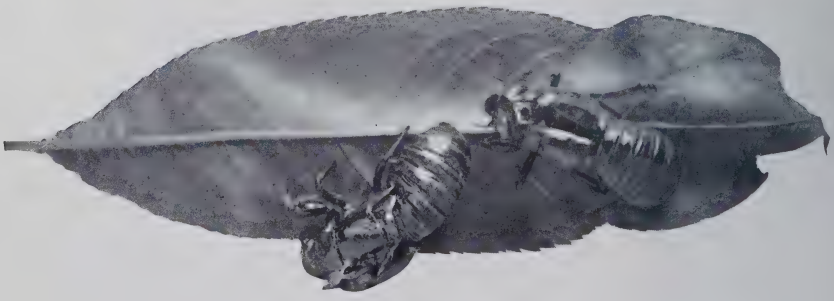


b. Twigs mutilated by the females in laying eggs.

THE PERIODICAL CICADA.

PLATE XXVI

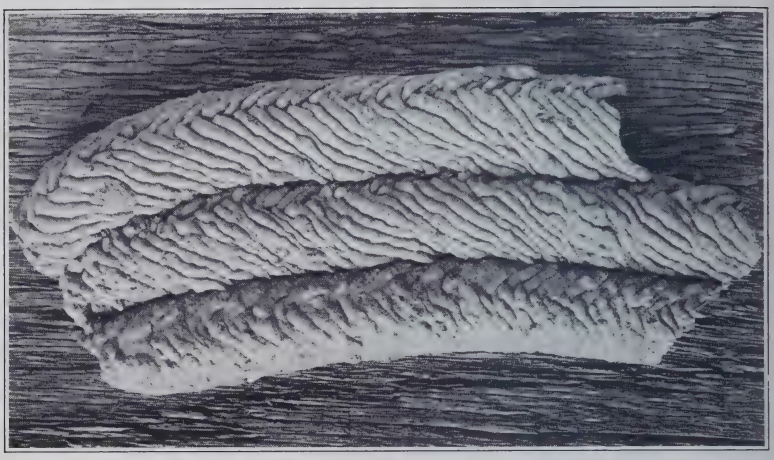




a. Apple twigs, splintered by periodical cicada; six years after injury, natural size.

b. Woodland in Westbrook stripped by cankerworms. Photo, June 22, 1928.

WORK OF PERIODICAL CICADA AND CANKERWORMS.



a. Nests of pipe organ wasp, natural size.

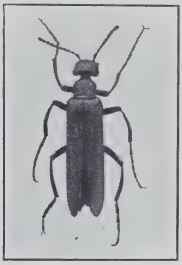
b. Male of pipe organ wasp, natural size.

c. Nests of pipe organ wasp, under side showing spiders in cells, natural size.

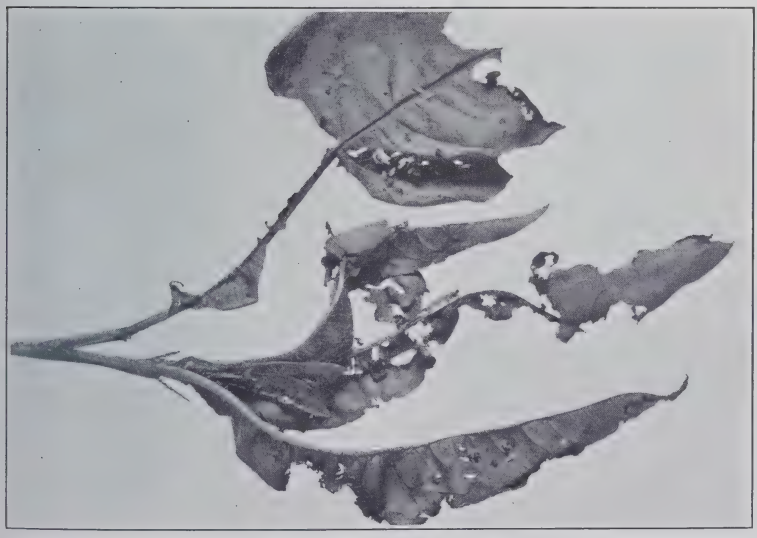
PIPE ORGAN WASP.

a. Spruce twig with leaves webbed together by spruce Epizeuxis, somewhat reduced.

b. Spruce Epizeuxis, adult moth twice natural size.



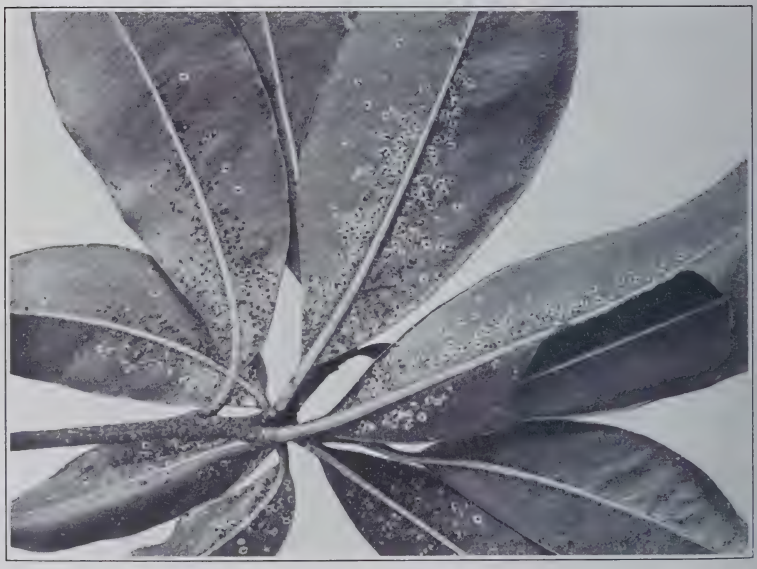
c. Say's blister beetle, natural size.



d. Peach foliage injured by Say's blister beetle, natural size.

SPRUCE EPIZEUXIS AND SAY'S BLISTER BEETLE

a. Mulberry whitefly on linden leaf, natural size.
(insert enlarged ten times)



b. The same on leaves of mountain laurel, natural size.

MULBERRY WHITEFLY

a. Magnolia branch showing flies killed by fungus, reduced.

b. Magnolia leaf showing dead flies, natural size.

CARRION FLIES KILLED BY FUNGUS.

a. Ditching through cat-tails. Quinnipiac marsh, Hamden. Spade raised to cut sod.

b. Removing the sod.

MOSQUITO CONTROL WORK

a. Breeding pools at South End marsh, East Haven, before ditching.

b. Same view; pools eliminated by ditching.

MOSQUITO CONTROL WORK

a. Marsh at Short Beach, Branford, where drainage has been restricted for years by trolley embankment.

b. Same marsh after ditching and enlarging outlet.

MOSQUITO CONTROL WORK.

a. A small section of an extensive breeding area, Great Island, Old Lyme.

b. The same area about one week after ditching.

MOSQUITO CONTROL WORK.

a. Eggs at left, mites at right, all greatly enlarged.

b. Phlox leaves injured by red spider, natural size.

GARDEN RED SPIDER

Bulletin 306 April, 1929

Connecticut Agricultural Experiment Station
New Haven, Connecticut

SOIL REACTION AND LIMING AS FACTORS IN TOBACCO PRODUCTION IN CONNECTICUT

By

M. F. MORGAN, P. J. ANDERSON AND HENRY DORSEY

The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to other applicants as far as the editions permit.

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LIMING experiments in many tobacco sections have shown that lime may be injurious, beneficial or of no effect, depending upon local conditions with respect to soil acidity.

The determination of soil reaction as measured in pH values, where 7 pH is neutral, with units below 7 increasingly acid and above 7 increasingly alkaline, affords a reliable method for indicating the effects which soil acidity may produce upon the tobacco crop.

The amount of lime required to produce a desired decrease in soil acidity can be predicted from pH tests with a fair degree of accuracy, provided the factors indicated in this bulletin are used for calculating the effect of soil texture and organic content.

A survey of the conditions of Connecticut tobacco fields with respect to soil acidity have shown that while a majority of the fields range between 5.0 and 5.6 pH, many are more acid or less acid than these limits.

Crop conditions on these fields indicate that tobacco on fields more acid than 4.8 pH are likely to be adversely affected, both in yield and quality, by such degree of acidity. On fields less acid than 5.6 pH, injury due to black root-rot is prevalent.

These observations are confirmed by field and greenhouse experiments.

Liming soils which are strongly acid improves the character of the burn and the whiteness of the ash of tobacco grown on such fields.

Tobacco grown on strongly acid soils is abnormally high in content of manganese. There are indications that poor tobacco on these soils may be due to an abnormal

concentration of soluble manganese in the soil and a consequent toxic effect upon the crop.

Liming the soil has reduced the absorption of potash by the tobacco plant, and has increased the necessity for liberal potash fertilization.

Some fertilizers, particularly sulfate of ammonia, increase soil acidity, while others, such as nitrate of soda, have the opposite effect.

Fields testing between 5.0 and 5.6 pH are in a satisfactory condition with respect to soil acidity. No lime should be used on such fields, and fertilizers which decrease soil acidity should be used with caution.

Fields more acid than 5.0 pH should not receive fertilizers with an acid tendency. At reactions between 4.6 and 5.0 pH, the equivalent of 1,000 lbs. of agricultural limestone per acre should correct the injurious degree of acidity on soils of average type for this section, while soils more acid than 4.6 pH may require as much as 2,000 lbs. per acre. Excessively sandy soils should be limed at somewhat smaller rates.

Fields between 5.6 and 6.0 pH may be made sufficiently more acid for protection against black root-rot by the selection of fertilizers with an acid tendency.

When the soil reaction is less acid than 6.0 pH, tobacco should not be grown. Other crops for a period of years, fertilized with acid-tending fertilizers may gradually restore a desirable degree of acidity.

Soil Reaction and Liming as Factors in Tobacco Production in Connecticut

By

M. F. Morgan, P. J. Anderson and Henry Dorsey*

Neutralization of the natural acidity of the soil by application of lime has a demonstrated value in the growing of many crops. The benefits thus derived have led to the inauguration of state wide liming campaigns in some sections. The publicity given to such propaganda involves the danger of creating the impression that liming is beneficial to all crops. However, it has been thoroughly demonstrated in the case of tobacco and potato crops that indiscriminate liming may be not only without benefit, but under certain conditions, positively harmful. On the other hand, it is a well-known fact that on some fields the application of lime has improved both the yield and the quality of tobacco. Such apparently contradictory evidence has not only confused the farmer, but also has confronted the agricultural scientist with the necessity of explaining such cases and of finding a method of indicating to the grower under what conditions he may expect beneficial results and why injury results at other times.

The principle effect of lime on soil is to change its reaction (degree of acidity). Since other substances which change soil reaction in the same direction have the same effect as lime upon the tobacco crop, it seems most likely that the reaction change produced by lime is primarily responsible for the effects observed on the crop. If this is a correct deduction, then the first and fundamental step in explaining these conditions and solving the difficulty is to answer the question:

1. *What is the optimum soil reaction for tobacco production?*

Corollary to this are the two questions:

2. *What is the effect of too much acidity?*
3. *What is the effect of too little acidity?*

The object of the present bulletin is to bring together the results of all the experimental work which has been done in the Connecticut Valley in trying to answer these questions, to summarize our present knowledge of the problem and to make it accessible to the growers and to other agricultural workers. Considerable data accumulated during recent years at Windsor, New

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Haven, and Storrs have not been published previously or only briefly presented in annual reports.

The steps followed in conducting the investigation were:

1. An extensive field survey in which the reaction of soil from over 2,000 tobacco fields has been tested.
2. Correlation of the reactions found with the condition of the tobacco grown on the fields.
3. Experimental plot tests with applications of lime and other soil amendments.
4. Greenhouse tests in pots.
5. Chemical analyses in the laboratory.

Previous Investigations

Until recent years no attempts have been made to determine the optimum degree of acidity of soil for tobacco production. Investigators in a number of states, however, have tried to measure the effects on the crop when soil acidity was partially or completely neutralized by application of lime. Without going into exhaustive detail, we present here the conclusions drawn from these liming experiments.

FIELD TESTS ON LIMING

Kentucky. On experimental fields in three different sections of the state two tons of limestone per acre were used where tobacco was grown in rotation with other crops. On the Lexington field there was no significant change in yield, on the Greenville field there was a decrease in yield while on the Mayfield soil there was an increase in one set and a decrease in the other. As a result of these tests Roberts, Kinney and Freeman (29) state that "Lime does not often benefit tobacco." The reaction of these soils before or after liming is not stated.

Tennessee. Mooers (20), in reviewing the results of six years of fertilizer tests on tobacco, states: "Liming was tested on several farms and at each place under a variety of fertilizer conditions, but no general conclusions can be drawn from the results except that tobacco does not appear to be very responsive to liming." During the next ten years, rotation experiments with tobacco, soy beans, wheat, grass and clover were tried at the Clarksville station on dark tobacco. In this rotation, two tons of ground limestone were applied to the wheat. At the end of the ten years (21) there was a difference in yield of only one per cent between the limed and unlimed tobacco. No records of the reaction of the soil are presented.

Ohio. Liming experiments on tobacco grown in a three-year rotation with wheat and clover were conducted at Germantown

(26) for 21 years. Lime was applied at the rate of 1,000 lbs. per acre (hydrated at first but limestone later) when fitting the land for tobacco. There were five pairs of plots in which lime was contrasted with no lime. When the yields were averaged at the end of 21 years it was found that in each of the five replications the yield of tobacco had been reduced. The reaction of this soil is not stated but since it "has been derived from glacial drift largely made up of limestone detritus" it may be inferred that it was not very acid at first. The fact that the depressing effect of lime was more noticeable during the latter part of the experiment indicates that root-rot may have played an important role here.

Maryland. Concerning an early experiment on liming in 1891 Patterson (27) states: "Lime injures the burning quality of tobacco and prevents its curing nicely." He finds the same effect also from magnesium salts.

In a later bulletin (28) Patterson also says: "Lime and magnesia compounds in small quantities seemed to produce but little effect, but in large quantities caused a growth that ripened unevenly and was hard to cure, yet with slightly improved combustibility, but on the whole, the application of lime immediately before planting of tobacco cannot be recommended."

In speaking of a later five-year series of experiments, Garner and Brown (16) state: "Where no nitrogen is supplied in the fertilizer, lime usually gives a considerable increase in yield, but where a nitrogenous fertilizer has been applied, no substantial benefit from liming is apparent. . . . . The effect of the lime in increasing the availability of the soils supply of nitrogen, however, is very marked and in fact, for this reason liming may produce a decidedly unfavorable effect on the quality of the tobacco crop under certain conditions. Farmers have frequently observed that liming a soil which is well provided with organic matter produces a dark colored and coarse textured leaf and the reason for this is that the lime makes available for the tobacco plant an excess of nitrogen. . . . While lime is not of great importance for the tobacco crop when supplied direct and even may be highly injurious, its direct action when applied to other crops may be highly beneficial."

New York. In experiments at Baldwinsville where 2,000 lbs. of burnt lime were applied once in four years there was an increase of 106 lbs. per acre in the cured tobacco. Collison and Harlan (10) state that the soils in this section are not abundantly supplied with calcium while a large part of what is present is not in carbonate form. The reaction of the soil is not stated.

Virginia. Green (17) speaking of results with suncured tobacco in rotation at Bowling Green says: "One half of each fertilizer plot is limed at the rate of 2,000 lbs. of burnt lime per

acre once in the rotation. In none of our experiments at Bowling Green has lime given marked beneficial results. Where lime was used on the ten plots the average gross value of the tobacco was 24 cents per acre less than where lime was not used. Our experiments covering four years and involving about 190 individual fertilizer plots have not shown sufficient results to warrant the use of lime." Chemical tests showed that this land had little need of lime, yet he continued: "Some farmers a few miles distant from the experiment field report beneficial results from lime. Perhaps this condition is only local." On another field he obtained a slight benefit from liming. Further Virginia tests are reported in the next section.

North Carolina, Georgia and Virginia Flue-cured tobacco. Rather extensive experiments conducted at various places in these three states have been described by Moss et al (25). It will be sufficient to quote from their summary: "It would seem from the foregoing results that the use of ground limestone on the soils represented is not likely to give increases in the yield of tobacco unless the limestone carries a considerable quantity of magnesia . . . . If potash salts carrying magnesia are used in quantities supplying 10-20 lbs. of magnesia per acre, under average conditions, little or no increase can be expected from the use of lime on tobacco. This is largely true at least with the fertilizer mixtures used in these tests, for in such mixtures, the phosphates used supply sufficient calcium for the plant food requirements of the tobacco crop. It is possible, however, that some tobacco soils are so acid as to require liming for best results independently of the plant nutrients in the soil." They warn against the excessive use of limestone on account of danger of root-rot and of liberation of ammonia. The actual degree of acidity on the plots is not stated except at Oxford, N. C., where it ranged from 5.66 to 5.98 pH before application of lime.

Canada. At the Ontario station when ground limestone was applied at the rate of 2,000 lbs. per acre for Burley tobacco, there was an average reduction of 158 lbs. per acre. Digges (12) states: "While the experiment has been conducted only one year and the results cannot be taken too conclusively, they very strongly indicate that liming . . . . is undesirable from both the standpoint of yield and quality." At Farnham, Quebec, a liming experiment was conducted on tobacco in rotation with oats and clover at rate of 2,000 lbs. of air slaked lime per acre applied early in the spring before fitting for tobacco. Summing up this experiment Montreuil (22) says: "In every case lime has had the effect of cutting down the yield and did not improve the quality of the leaf." In a later experiment on this same field tobacco was grown continuously for three years (1925-27) with the same lime

application as above. Slagg, Montreuil and Major (30) state concerning this experiment: "Significant decreases in yield and quality were secured wherever lime was applied during each of the three years of the experiment."

Connecticut. In the Poquonock experiments of 1892-96 where tobacco was grown continuously there were two pairs of plots contrasting lime at an annual rate of 300 lbs. per acre with no lime. Differences in yield, rank and fire-holding capacity of the tobacco were insignificant. No records of the soil reaction before or after liming were presented. Jenkins (18) drew no conclusion from this experiment but the data presented show that lime applied at this rate had no appreciable effect on the crop.

Massachusetts. Where tobacco was grown continuously and heavily limed (1 to 2 tons) each year, Anderson, Osmun and Doran (3) found the yield increased at first but later it was very much reduced and the roots were badly infested with the black root-rot organism.

Conclusions to be drawn from field liming tests in the principal tobacco growing sections of America. It is apparent from these published accounts that liming has been widely tested and that all the information which may be gained from routine lime plots is at hand. Briefly it is:

1. Lime may be injurious, beneficial, or neutral in its effect on tobacco.
2. Not only are the yield results different for the various sections but even in the same state the effect may be different, for example, Virginia.
3. On the same field liming may be beneficial at first but injurious later; for example, Ohio and Massachusetts.
4. Although results in most cases have been measured solely or mainly in yield, impairment of quality has also been mentioned in Maryland and in Canada.
5. None of the investigators mentions an improvement in quality.
6. No attempts have been made to correlate the effects observed with the changes produced in reaction of the soil, except for the Massachusetts experiments.
7. The injurious effects in a few of the more recent tests have been ascribed to promotion of black root-rot. In the most recent Canadian experiment it was suggested that the decrease in yield was due to lime without respect to root-rot. In Maryland it was thought that impairment of quality was due to too rapid liberation of nitrogen.
8. No explanation of beneficial effects is attempted but it is not believed that there was an actual shortage of nutrient calcium in any case, with the possible exception of the New York experiment.

BLACK ROOT-ROT AS AN EXPLANATION OF INJURIOUS EFFECT OF LIMING

Working in the Connecticut Valley in 1907 Briggs (7) was the first investigator to call attention to the fact that black root-rot was most severe where the land was made more alkaline by the use of such materials as lime, wood ashes, and carbonate of potash. He made no attempt, however, to measure the degree of acidity in question.

The same conclusion was reached by Beals (6) in Massachusetts from his field survey in 1915. This work was continued by

FIG. 66—Field of tobacco, showing black root rot on soil which is not sufficiently acid to prevent injury from this disease.

Chapman (9) who was the first to attempt to measure and correlate the soil reaction with root-rot. He determined the reaction of soils from a large number of tobacco fields by the Jones lime requirement method and by comparing the reaction with the condition of the tobacco on each field he came to the following conclusion:

"The tobacco soils of Massachusetts fall into three groups, as regards acidity. Soils with a lime requirement up to 3,000 lbs. per acre are not producing good crops, as a rule and are comparatively free from root-rot. Those with a lime requirement of from 3,000 to 8,000 lbs. CaO per acre are in good tobacco condition; but in this group pathogenic fungi are abundant in the soil, and

the plants during certain seasons are very liable to suffer from root-rots, caused by some of these fungi. Soils with a lime requirement of 8,000 pounds CaO up are usually comparatively free from such fungi, and even in unfavorable seasons little disease is found, but the tobacco is perhaps of slightly inferior quality."

In pot experiments Johnson and Hartman (19) confirmed in general the conclusion of Briggs, Beals and Chapman that an acid soil checks the severity of the disease. Using the Truog method of determining lime requirement they found the disease much reduced in soils more acid than a lime requirement of 4.6 tons. They also showed, however, that the critical reaction shifted with the susceptibility of the variety, Burley being badly diseased at a reaction which inhibited disease on Connecticut Havana.

Anderson, Osmun and Doran (3) were the first to correlate severity of infection with soil acidity as measured by the hydrogen-ion method. Working with field plots artificially inoculated and limed, they came to the following conclusions at the end of five years:

1. The immediate effect of liming an acid soil was to increase the yield of tobacco.
2. If sufficient lime is added, black root-rot is ultimately promoted and there is consequently a reduction in yield.
3. Black root-rot is present in most soils but is more injurious in nearly neutral soils because the causal fungus, *Thielavia basicola,* grows more rapidly and vigorously in a nearly neutral medium.
4. In the field under experimentation, black root-rot caused little or no loss in soils more acid than pH 5.6. It caused severe loss on all soils less acid than pH 5.9. It should be understood that this critical region between pH 5.6 and 5.9 is an intermediate zone which may be shifted to a somewhat higher or lower position by variations in temperature and compactness of soil and by differences in the degree of infestation of the fungus in the soil.
5. As the soil becomes less acid, above pH 5.9, the loss from black root-rot increases.
6. After repeated applications of lime brought the soil reaction to a point favorable to the fungus, the omission of lime for two years, with tobacco grown continuously meanwhile, did not result in any immediate reduction in the severity of black root-rot.

Soil Reaction, Soil Acidity and Lime Requirement—Some Brief Definitions:

In the sense considered in this bulletin, the term "soil reaction" is used to indicate the degree of intensity of acidity or alkalinity which exists in the soil. It is now quite generally expressed in

terms of "pH," on a scale where 7 pH (approximately) indicates the neutral point (neither acid nor alkaline) while lower units of pH, for example, 6 and 5 pH, indicate increasing degrees of acidity, while pH units above 7, such as 8 and 9, indicate alkalinity.

"Soil acidity" is a broader term, which includes not only the acid soil reaction, the intensity of which is measured in terms of pH, but the characteristic conditions of the soil which are related either directly or indirectly to such acid reaction.

Increasing degrees of soil acidity in a group of soils of varying reaction is usually evidenced by most, if not all the following conditions:

1. There is an increase in intensity of soil reaction, as indicated by pH values farther and farther below 7.
2. A decrease is to be found in the content of easily liberated (replaceable) lime and magnesia.
3. The more strongly acid soils may show a considerable concentration of soluble aluminum and maganese, with a consequent toxicity to the plant.
4. Carbonates of lime or magnesia when mixed with the moist soil are decomposed, with an absorption of the bases and an evolution of carbon-dioxide gas. The amount of lime which will be absorbed by the soil in this manner is greater on the more acid soils.
5. Nitrogen fixing bacteria which are free-living in well drained soils diminish or cease their activities and there is a decreasing effectiveness of legume bacteria and nitrifying organisms on the more acid soils.
6. In general, the rate of decomposition of soil organic matter is diminished at higher degrees of acidity.

It is not possible to say with assurance whether the other conditions are the cause or the result of the first one named, or that any or all of them are the result of some more remote soil processes which are evidenced only through these phenomena.

The "lime requirement" of a soil is commonly accepted as indicating the amount of lime, as burnt lime, hydrated lime, limestone or marl, which is required to bring the soil from its acid reaction to a condition of approximate neutrality, (7 pH.) It can be measured with a fair degree of accuracy by a number of chemical methods, and the results are expressed in terms of the number of pounds or tons of calcium oxide or calcium carbonate equivalent which the soil can absorb without becoming alkaline. The lime requirement of the soil is not the same as the lime requirement of the crop, since the crop may not require a neutral reaction and it may be desirable to maintain a certain degree of soil acidity.

A more complete statement in regard to the nature of soil acidity is given in Connecticut Agricultural College Extension Bulletin No. 101, while an exhaustive discussion of methods of measurement of soil acidity has been published by Conner, Morgan and Conrey (11).

A Study of Methods for Measurement of Soil Acidity

In the course of this survey four methods for the quantitative measurement of soil acidity were used. When the work was begun in 1925 the Stirlen double-wedge apparatus was the one immediately available for measuring pH values. This was used on two hundred soils. It was found that within the range of the bromthymolblue indicator (6.0-8. 6 pH) the data obtained were consistent with expected results. But soils of greater acidity, as measured by chlorphenol red, methyl red or bromcresol purple, tended to give results much nearer the same value—about 5.75 pH, than would be expected in a normal frequency distribution range. As soon as possible, a hydrogen-ion concentration apparatus for the electrometric determination of pH values, employing the gas chain hydrogen electrode, was set up and the "double-wedge" results were checked by this method. It was immediately apparent that the soils under investigation varied over a much wider range of pH values than had been found by the double-wedge method, and that soils below 5.75 pH were much lower in pH when measured by the hydrogen electrode. The following table shows a typical comparison of results by the two methods:

Table 1. Comparison of Double-wedge and Hydrogen Electrode Methods for Measurement of pH Values

Soil No.	Double-wedge	H.-Electrode
1	5.65	4.76
8	5.75	4.89
187	5.75	5.00
201	5.80	5.85
207	5.85	5.51
209	5.75	5.56
211	5.90	6.16
214	5.70	5.78
217	5.75	5.58
218	5.70	5.21
222	5.90	6.01
273	5.90	5.36
282	5.80	5.08
294	6.20	6.51
302	5.80	5.38

It was therefore decided to discard the double-wedge method.

At about this time the Morgan soil testing set (23) was developed by one of the authors and it was decided to make pH tests by both this and the electrometric apparatus, which was the procedure on about twelve hundred soils.

The gas chain hydrogen electrode was replaced by the more rapid and convenient quinhydrone electrode in the electrometric measurement, since the results of the two methods were found to be in close agreement.

The standard procedure finally adopted for determination of pH by the quinhydrone method is as follows:

> 10 gms. of freshly collected soil, 10cc of distilled water and approximately 10 mgs. of quinhydrone are stirred together for about one minute and the pH determined at once by means of a Leeds and Northrup Type K potentiometer, with the customary standard cell, storage battery and galvanometer. The half-cell used is the .01 N. HCl-.09 N. KCl quinhydrode half-cell described by Veibel (31). Connection with the half-cell was made by means of a saturated KCl agar bridge. Constant readings were obtained within a couple of minutes.

After several hundred soils had been tested independently by the Morgan soil testing set by the staff at the Tobacco Substation at Windsor and by the quinhydrone electrode at the Soils laboratory at the New Haven Station, a tabulation of 626 soils showed the following discrepancies between the results of the two methods:

.0—.1	pH—	239	soils
.1—.2	" —	165	"
.2—.3	" —	134	"
.3—.4	" —	54	"
.4—.7	" —	24	"

As a result of these comparisons, it was decided that the Morgan soil testing set was of satisfactory accuracy for general field use, but that the special features of this investigation necessitated the use of a standard method which was independent of the personal factor involved in colorimetric measurement. Hence the quinhydrone-electrode results were the ones selected for final tabulation, and in subsequent measurements this was used exclusively for determining pH values.

Since the earlier investigations of Chapman (9) were conducted prior to the general adoption of pH measurements in soil studies, and his conclusions were based on the Jones lime requirement method, it was desirable to compare the pH values with the results of this method. 650 soils were sent to the Connecticut Agricultural College and the lime requirements in terms of lbs. of $CaCO_3$ per 2,000,000 lbs. of soil were determined by the modified Jones method used by Dorsey (14).

An inspection of the data obtained on these soils by the two methods showed that while there is a general relationship between the two sets of results, there were many wide discrepancies. This is shown in the following table, which includes 25 soils obtained at random by selecting every tenth soil in the series:

TABLE 2. COMPARISON OF JONES LIME REQUIREMENTS AND pH VALUES

Soil No.	pH	$CaCO_3$ Requirement in lbs. per 2,000,000
660	6.16	1,290
470	6.07	2,258
530	5.93	1,774
650	5.86	2,258
600	5.85	1,935
560	5.83	2,580
520	5.70	4,193
370	5.59	3,708
590	5.57	2,903
620	5.55	2,903
540	5.50	3,386
630	5.48	3,870
550	5.39	2,580
390	5.38	4,515
430	5.28	2,580
670	5.22	5,483
510	5.10	1,935
440	5.04	4,031
480	5.03	3,581
490	5.03	2,903
420	4.95	3,870
380	4.92	7,095
570	4.89	3,548
540	4.86	5,966
500	4.52	3,870

These results are in agreement with the work of Carleton (8), who also pointed out that there was a general correlation when soils of the same textural classes were grouped together.

The soils included in our studies represented a considerable range of texture and organic content. The Jones method is essentially a measure of the absorption of the calcium-ion from a salt of a strong base (calcium) and a weak acid (acetic acid) thus leaving free acetic acid with a readily titratable acidity in direct proportion to the amount of calcium absorbed. It follows that the acidity thus measured depends not only upon the pH of the soil, but upon the absorptive surface of the soil. The latter will depend upon both the texture and the organic content of the soil.

The soils which had been tested for pH and lime requirement were examined carefully by a trained soil survey worker, who estimated the texture and relative amount of organic matter of 551 of these soils which had been preserved for future study. The pH and Jones $CaCO_3$ requirement were then graphically plotted, with a separate graph for each textural group, variations in or-

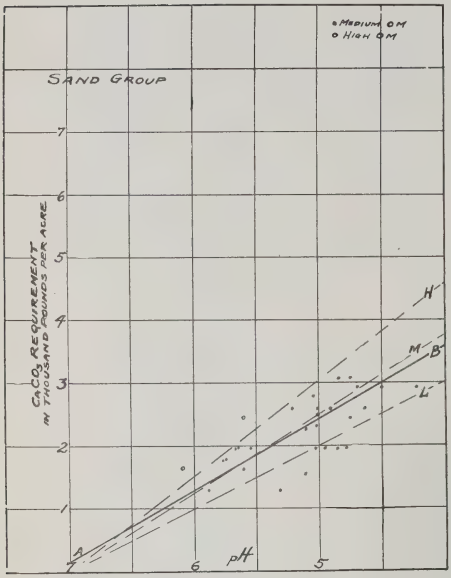


FIG. 67

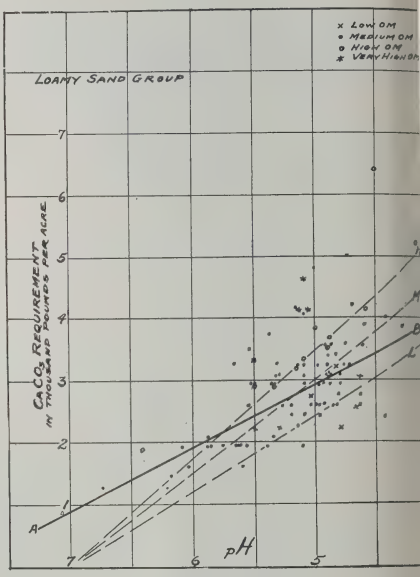


FIG 68

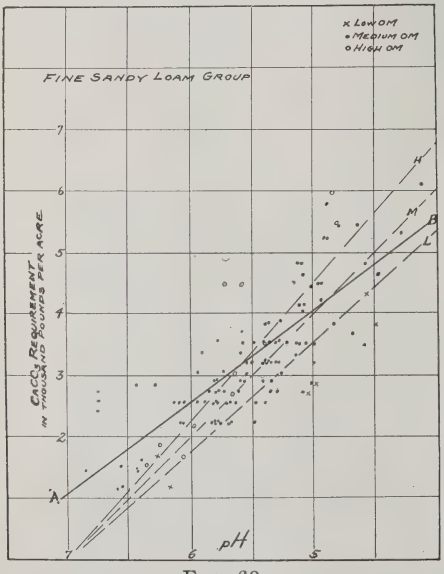


FIG. 69

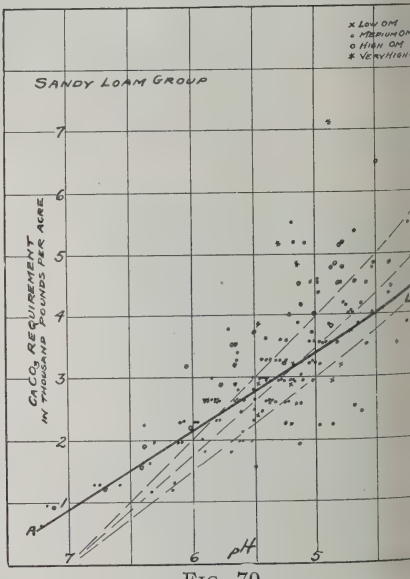


FIG. 70

The relationship between pH, lime requirement, soil texture and organic content.

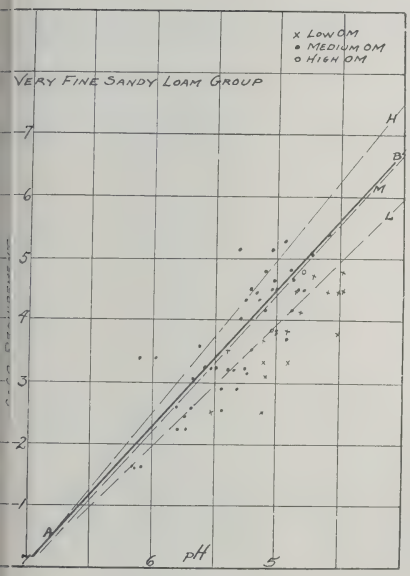


Fig. 71

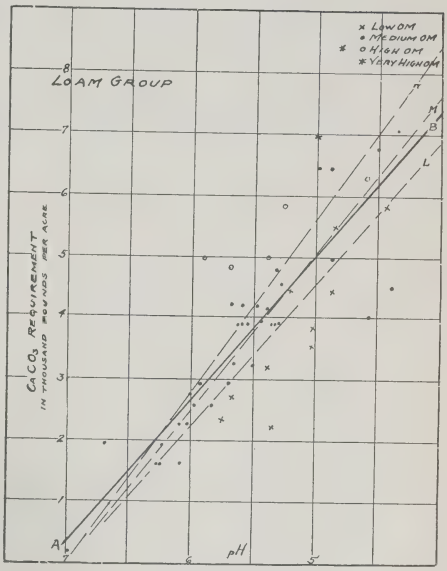


Fig. 72

The relationship between pH, lime requirement, soil texture and organic content.

ganic content being represented by symbols, for low, medium, high and very high amounts. It was immediately apparent that a definite correlation existed between pH and Jones lime requirement where soils of the same texture and organic content were compared. See figures 67 to 72.

Two groups of soil with more than a hundred individuals in each, the fine sandy loam and sandy loam groups, both with medium organic content, were selected for computation of correlation coefficient. The result are as follows:

Soil group	Correlation Coefficient
Fine sandy loam, medium organic content . . .	$.757 \pm .015$
Sandy loam, medium organic content	$.856 \pm .026$

While a perfect correlation (1.000) is far from being attained, yet in consideration of the fact that the texture and organic content were estimated from observation rather than actually determined by mechanical analysis and laboratory method of organic matter determination, the results are in surprising agreement.

Figures 67 to 72 also show, as line AB, the mathematically determined regression lines for soils of average organic content in

each textural grouping. The factors computed from these lines are as follows: where

$$Y = A - B(7 - X)$$

Where $Y = CaCO_3$ requirement at X pH in lbs. per 2,000,000
$A = CaCO_3$ requirement at 7 pH in lbs. per 2,000,000
X = determined pH value

Soil group	Value A	Value B
Sands	225	1,100
Loamy sands	925	1,000
Sandy loams	900	1,390
Fine sandy loams	1,100	1,500
Very fine sandy loams	25	2,225
Loams	400	2,325

It is apparent from the above table that soils at 7.00 pH invariably give a positive $CaCO_3$ requirement. It is also seen that the slope of the curve increases with increasing fineness of texture, with the exception of the sands group, which had a relatively small number of individuals, with a poor distribution of soil in the neighborhood of 7.0 pH, which would tend to steepen the slope of the regression line.

An inspection of the graphs shows that soils with high organic content give higher lime requirements at the same pH value than those of medium organic content, while the reverse is true of soil low in organic matter.

For the purposes of simplification, it appeared desirable to assign arbitrary values in definite units to indicate a straight line correlation between pH and lime requirement, with a zero line requirement at 7.0 pH, which would fit the distribution of points on the graphs to the maximum degree. After considerable trial and error, the following factors were selected, to be substituted in the equation $Y = 1{,}000K(7 - X)$:

Where $Y = CaCO_3$ requirement in lbs. per 2,000,000
X = determined pH value

Texture	Organic Content	Value of K
Sands	low	1.00
"	medium	1.25
"	high	1.50
Loamy sands	low	1.25
" "	medium	1.50
" "	high	1.75
Sandy loams	low	1.50
" "	medium	1.75
" "	high	2.00

Texture	Organic Content	Value of K
Fine sandy loams	low	1.75
" " "	medium	2.00
" " "	high	2.25
Very fine sandy loams	low	2.00
" " " "	medium	2.25
" " " "	high	2.50
Loams	low	2.25
"	medium	2.50
"	high	2.75
Silt loams	low	2.50
" "	medium	2.75
" "	high	3.00

Lines L, M and H, computed from these arbitrary values for low, medium and high organic contents, respectively, are shown on the graphs.

The degree of error in estimate of lime requirement from pH value by means of these lines as compared to the Jones lime requirements was computed for each soil studied. The results of these comparisons are as follows:

Error of estimate in lbs. $CaCO_3$ per 2,000,000	Percent of Soils
300 or less	37.56
500 " "	68.96
1000 " "	90.19
1500 " "	96.91
2000 " "	99.45
2300 " "	100.00

Mean error of measurement: 509.2 lbs.
Standard deviation: 600.9 ± 12.21 lbs.

A similar type of correlation between pH values and lime requirement was attempted by Arrhenius (5), who gives the following table as the amount of hydrated lime in Kg per hectare (approximately the same as lbs. per acre) to change the soil reaction 1 pH unit in the alkaline direction:

Soils	Poor in Humus	Average Humus	Rich in Humus
Sandy	500	1000	1500–3000
Fine sandy	500–1000	1000–1500	2000–3000
Light clay	1500	2500	3500
Average clay	2500	3500	4000
Heavy clay	3000	4000	4500

Humus soils with 15 per cent organic matter—4000–8000

It is believed that with soils of the types represented in these studies, the lime requirement can be estimated with reasonable ac-

curacy for all practical purposes from determinations of pH values, using appropriate factors depending upon the texture and organic content of the soil. Accuracy within 1,000 lbs. CaCo per acre is sufficient, since rates of application of limestone are usually made to the nearest half ton quantity.

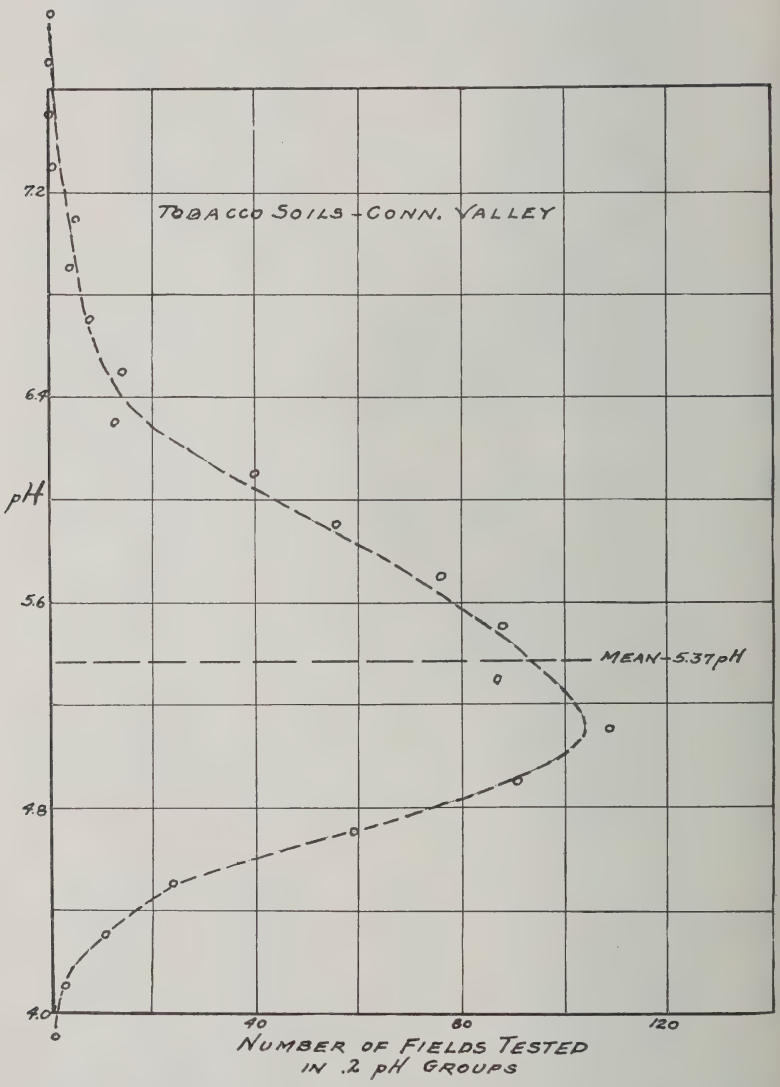


FIG. 73—Distribution curve, showing range of soil acidity on tobacco soils of the Connecticut Valley.

Distribution of Soil Acidity in the Connecticut Valley Tobacco District

The results of electrometric pH tests of soil samples from seven hundred tobacco fields* have been brought together and graph-

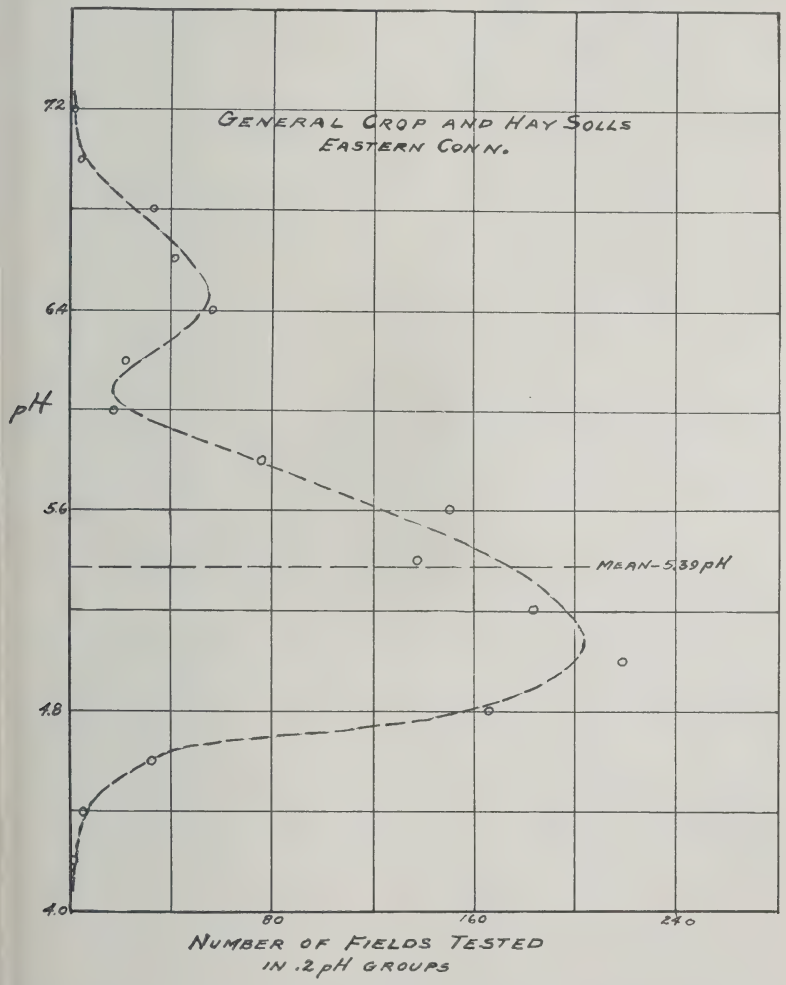


Fig. 74—Distribution curve, showing range of soil acidity on eastern Connecticut dairy farms.

*We are indebted to J. S. Owens, Extension Agronomist, Conn., Agr. College, and B. G. Southwick, County Agent, Hartford County, Conn., for assistance in collecting these samples.

ically plotted as a frequency distribution curve in figure 73. The soils ranged from 8.2 pH to 3.9 pH, with a pronounced modal point at 5.2 pH. The mean of all soils tested was 5.37 pH. Eighty-one per cent of the soils had pH values between 4.6 and 6.0 pH.

The prevailing condition of the soils of the Connecticut Valley tobacco district is thus found to be one of moderate to strong acidity. An inspection of figures 67 to 72 does not reveal any particular tendency for one type of soil to be more acid than another. Since all of the soils are derived from non-calcareous material, the degree of prevailing acidity is not surprising. In fact, twelve soils from areas adjacent to tobacco fields, and which are wooded, brush or waste land, showed pH values ranging from 4.7 to 5.4, with an average of 4.91 pH. This suggests that tobacco culture with the type of fertilization usually followed has produced a slight tendency toward reducing the acidity of the soil.

On most fields no lime has ever been applied. Wood ashes and cottonhull ashes have been used on a large number of fields, and in recent years carbonate of potash has been used to some extent. Records as to the use of lime at some time in the past are so incomplete that it is impossible to state accurately what percentage of these tobacco lands has been limed. As a rough estimate based on the number of fields on which there is a definite record of recent liming and the belief that liming was more prevalent some years ago before black root-rot was suspected of being associated with the heavy use of lime, it is believed that from 30 to 40 per cent of the fields have been limed. The usual practice was a light application of 500 to 1,000 lbs. of hydrated lime per acre once every two or three years.

Lime in the Connecticut Valley tobacco district has not been used in sufficient quantity to bring many of the soils upon which it has been used to significantly different pH values from those to which no lime has been applied. This is seen in a comparison of figure 73 with figure 74, which shows the frequency distribution curve of pH values of soils from 914 fields from the eastern highland of Connecticut. This curve shows a pronounced bimodal tendency, with a mode of about 5.1 pH for unlimed soils and 6.4 for limed soils. The practice in this region is to lime heavily if lime is applied at all.

Crop Conditions at Varying Degrees of Acidity

When the soil samples were taken notes were also made as to the condition of the crop. However, since the samples were taken at a time of the year when the land was bare, it was necessary to rely on the memory and statement of the grower as to whether the crop was good, fair or poor. In most cases where

black root-rot was suspected, careful examination of the roots were made by an experienced pathologist.

An attempt has been made to tabulate the records of all the fields upon which there was an estimate of crop conditions. This is shown in table 3.

TABLE 3. CROP CONDITIONS AS RELATED TO SOIL ACIDITY

No. of Soils in Group	Reaction Range	Percentage of Soils in Group: No Black Root-rot Record — Very Good Crop	Fair Crop	Poor Crop	Black Root-rot — Moderate	Severe
54	6.4 pH or above	19	2	54	7	18
119	5.8 6.4 pH	44	16	35	3	2
406	5.2 5.8 pH	61	25	13	1	0
193	4.6 5.2 pH	54	26	20	0	0
71	Below 4.6 pH	36	24	40	0	0

Black root-rot infestation is particularly severe on soils above 6.4 pH. Entirely satisfactory crops are found on a decreasing percentage of the fields above 5.8 pH, and below 5.2 pH. However, the percentage of poor crops remained relatively low between 4.6 and 5.8 pH.

As indicated by these results, tobacco in the Connecticut Valley is practically safe from black root-rot troubles and produces best results under the moderately acid conditions ranging from 5.2 to 5.8 pH. Increasing acidity beyond 5.2 pH has adversely affected the crop, particularly below 4.6 pH.

FIELD EXPERIMENT WITH A VERY ACID SOIL

In the course of the soil reaction survey a field belonging to Mr. J. E. Phelps in Suffield was found to be unusually acid (3.9 pH). Although the soil was of a favorable type, was highly fertilized, and in earlier years had produced large yields of good tobacco, the crop in more recent years was very poor both in yield and quality. When first observed by the writers in 1925, there was only one spot in the field where growth appeared normal. On this spot the owner had burned stalks and the reaction was found to be 5.2 pH. Examination of the roots showed that no form of root-rot was responsible for the poor growth. The leaves of the plants showed the characteristic yellow spotting which we later associated with manganese toxicity. Since this combination of conditions led us to believe that the trouble was due to a too acid condition of the soil, a series of plots was laid out on this field in 1926 for the purpose of determining what benefit could be derived from applications of lime and also of superhosphate. Lime was applied at rates of 1,500, 3,000 and 5,000 lb. CaO per acre; superphosphate at rates of 1,000 and 2,000 lbs. per acre. The response to the higher applications of both lime

and phosphate was very definite and striking. The tobacco on these was quite normal in size and appearance while the untreated plots were again abnormally stunted and the leaves showed the same spotting as on previous crops. The lower applications were beneficial but to a less degree than the higher ones. The experiment was repeated the following year on different plots with much the same results. The best tobacco was produced on the 1927 plots which were treated with a combination of 2,000 lbs. lime and 1,500 lbs. superphosphate.

Pot experiments with soil from the above field, conducted at the New Haven Station showed marked improvement in growth of Turkish tobacco from applications of lime, although heavy applications of phosphorus in the form of orthophosphoric acid, equivalent to 3,000 lbs. of superphosphate per acre, failed to show any response. Similiar results were obtained from the growth of barley on this soil.

In experiments on the station farm it was learned that the tobacco leaves take up considerably more manganese (see Tobacco Station reports for 1927 (2) and 1928 (4)) from an acid soil. Apparently in a *very* acid soil, the amount of manganese absorbed becomes toxic. When the manganese in the soil is thrown out of solution by application of lime or supherphosphate, it is not absorbed in sufficient amount to interfere with growth and the plant develops normally. All tobacco contains a small amount of manganese, but experiments have failed as yet to show that this is essential to the plant.

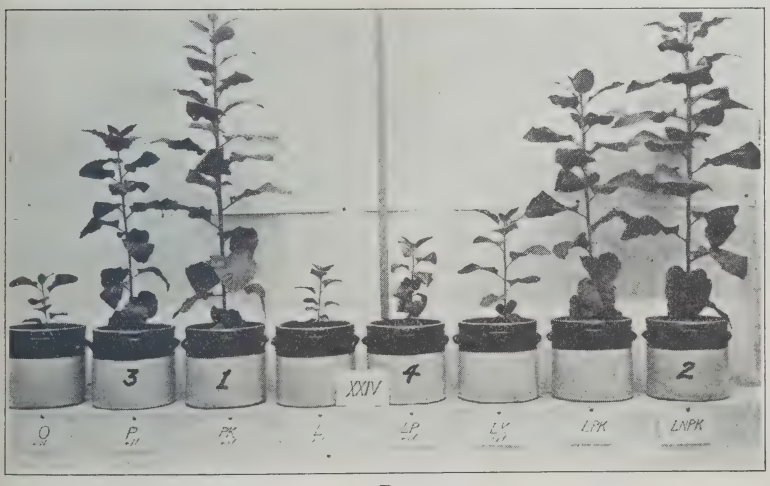
There is also the possibility that alumina in these very acid soils may become toxic to tobacco. This substance also would be rendered insoluble by lime or superphosphate. This is another possible explanation of the benefit derived from liming such soils.*

Pot Experiments With Tobacco Grown on Twenty-Four Connecticut Soil Types

Incidental to a study of the fertilizer and lime requirements of typical Connecticut Soils, Turkish tobacco, a strain of high uniformity and well suited in habits of growth to greenhouse conditions, was grown as a test crop to reveal soil differences. Certain phases of the results of these investigations, while summarized elsewhere (24), are of special interest in connection with the effect of soil reaction.

*During a recent visit to the tobacco sections of Cuba, one of the writers (Anderson) had occasion to test soils from many fields, which showed the same type of stunted growth and yellow mottled leaves which we have considered characteristic of manganese toxicity in the Connecticut Valley. All these soils uniformly tested below 4.6 pH, while adjacent soils where tobacco was normal tested above 4.6. Growers there have known for years that such a condition could be overcome by the application of lime.

A



B

FIG. 75—Greenhouse pot experiments with tobacco, showing effect of lime on two different soils. No. XXVII shows marked response to lime, comparing (2), with lime, (1) without lime, both completely fertilized. No response to lime is observed on No. XXIV. Note also that lime without potash—(4) has reduced growth and produced potash starvation symptoms on both series as compared to unlimed without potash—(3).

Twenty-four soils were studied in greenhouse pots, with various combinations of nitrogen, phosphorus and potassium, with and without lime. These soils represented most of the important soil types of the entire state. Only two of them were from old tobacco fields, the others being chiefly from old hay fields. Two crops of tobacco were grown on these soils in 1928, and with one exception, to be noted later, the results were similar for both crops. The results of the second crop, showing a comparison between the complete fertilizer—NPK—and the complete fertilizer and lime—LNPK—yields, are summarized in table 4.

TABLE 4. GROWTH OF TOBACCO ON LIMED AND UNLIMED SOILS IN GREENHOUSE POTS.

Soil Reaction NPK (pH)	Soil Reaction LNPK (pH)	Yield NPK compared with LNPK %	Pot Series
4.01	6.8	17.61	XXVII
4.55	6.86	79.63	XXXIV
4.59	7.23	29.44	XXXVII
4.73	6.62	47.45	XIX
4.73	6.71	69.71	XVII
4.75	6.92	92.25	XXXI
4.75	6.77	102.70	XXVIII
4.80	6.98	92.39	XXV
4.81	6.83	74.14	XVIII
4.88	6.82	115.43	XXXV
4.90	6.98	111.14	XV
4.91	6.66	120.79	XXX
4.91	6.40	112.56	XXXII
4.97	7.03	104.20	XXI
4.97	6.60	96.86	XX
5.05	7.16	125.86	XXIV
5.06	6.80	131.14	XXXIII
5.09	7.40	95.66	XIII
5.11	6.48	95.27	XVI
5.12	6.29	128.30	XIV
5.16	6.87	87.97	XXIX
5.18	7.16	122.21	XXVI
5.52	6.38	111.28	XXXVI
7.48	7.55	120.90	XXII

From the above table it is apparent that no consistent benefit from the use of lime is obtained at reactions above 4.88 pH, and one soil at 4.75 pH yields better without lime than when limed to 6.77 pH. Above 4.88 pH eleven soils gave reduced yields when limed, while four soils were slightly improved.

Black root-rot was not found on any of the limed soil, since only two of the soils had previously been cropped to tobacco, and these had not been infested in the field.

A most striking result in these experiments was the reduction in yield on limed pots when potash was not applied. With the exception of two soils which failed to show any response to pot-

ash, the yield was reduced on the LNP pots as compared with the NP pots, and the symptoms of potash hunger were much more apparent on the lime pots. It appears that where potash is a limiting factor in the soil, the correction of acid condition by the application of lime reduces the availability of the soil potash to the plant.

Two soils in the above experiment, both very strongly acid, exhibited peculiar physiological conditions on one or both crops

A—Series XXV, first crop. B—Series XXVII, second crop.

FIG. 76—Tobacco plants grown in complete fertilizer pots without lime on two very acid soils.

on the unlimed treatments. Series XXV, at a pH of 3.96 on the NPK pots during the growth of the first crop, produced plants having all their leaves very highly mottled over their entire surface. Certain patches on the leaves where the mottling was most pronounced were wrinkled and distorted and small spots of the tissue turned brown and fell out later. The plants were of fair size on the well fertilized plot in spite of the peculiar growth. This soil was examined for soluble aluminum and manganese during the growing period of the first crop, and the completely fer-

tilized pots without lime showed 322 lbs. of aluminum and 816 lbs. of manganese per acre soluble in .5 Normal acetic acid.

The second crop on this soil did not show these abnormal effects. The growth was normal in appearance on the unlimed pots, though it showed a somewhat increased growth with lime. The acidity had become reduced from some unknown cause to 4.80 pH on the same pots which had formerly tested nearly 1.0 pH more acid. The soil was again analyzed for soluble aluminum and manganese, and showed that the soluble aluminum content was practically unchanged, while the soluble manganese content was reduced to 32 lbs. per 2,000,000. The abnormal plant grown in the NPK pot from this soil is shown as "A" in figure 76.

The other abnormal soil produced plants somewhat like those described above, but much more stunted and with the mottled condition of the leaves localized in certain areas where the tissue was much wrinkled and distorted and brown spots of considerable size developed. The lower leaves especially showed a "marbled" appearance. During the first crop the soil on the PK treatment showed a reaction of 3.96 pH, and the aluminum and manganese soluble in .5 N. acetic acid was 666 and 68 lbs. per 2,000,000 respectively. The second crop showed similar results. The PK treatment soil then was practically unchanged—4.01 pH, and the soluble aluminum and manganese was practically unchanged. The abnormal plant grown on the NPK pot from this soil is shown as "B" in figure 76.

The Effect of Fertilizers on Soil Reaction

In view of the influence which soil reaction may thus have on the growth and quality of the crop it is well to inquire what effect the continuous application of the ordinary tobacco fertilizer materials has on the reaction of our soils. The fertilizer plots at the Windsor station have offered opportunities for answering this question for a number of the substances. Some results have been published in the reports for 1927 and 1928. It will be sufficient here to merely refer to these and to results at other stations where similar tests have been made.

Cottonseed meal, castor pomace, linseed meal, tankage, hoof meal, horn meal. These organic ammoniates have had a tendency to make the reaction very slightly more acid. The change, however, is not pronounced and from a practical standpoint may be disregarded.

Dry ground fish on the Windsor plots made the soil somewhat more acid than the preceding materials but even here the change was small.

Urea for the first few weeks causes the soil to become more alkaline but after this it drops down until it is slightly more acid.

Nitrate of soda has the strongest tendency toward alkalinity of any of the ordinary ingredients of the tobacco mixture. This may be seen from the comparative reaction of four plots on the station farm at the end of the three years during which each plot received its nitrogen supply in a different carrier:

	pH
Cottonseed meal plot	5.08
Nitrate of soda plot	5.50
Sulfate of ammonia plot	4.64
Synthetic urea plot	4.92

Nitrate of lime has the same tendency as nitrate of soda but, according to a two year test at the station, to a somewhat less degree.

Sulfate of ammonia has a *pronounced* tendency toward acidification as indicated in the table above and as discussed fully in the tobacco station reports for 1927 and 1928. This is also supported by investigations at many other stations too numerous to cite at this time.

Carbonate, sulfate and nitrate of potash. Of these three most common sources of potash in the tobacco mixture, sulfate is reputed to make the soil slightly more acid, while carbonate is said to reduce the acidity. In a four year experiment at the tobacco station farm where each of these carriers was used on separate adjacent plots it was found that none of them had a measurable effect in changing the soil reaction during that time. In a greenhouse experiment, however, where the important factor of leaching was eliminated, it was found that carbonate reduced acidity by .3 of a pH unit.

Superphosphate (acid phosphate) *precipitated bone, bone meal and steamed bone* all make the soil slightly less acid.

Cottonhull ash theoretically should make the soil considerably less acid on account of the carbonates of calcium, magnesium and potassium contained. No tests covering a sufficiently long period, however, have been made.

Wood ashes has a strong alkaline tendency.

Manure. The effect of manure is to make the soil less acid. The degree of change on a coarse sandy loam may be judged by the reactions of the manure and adjacent plots at the tobacco station at end of third year of treatment.

Plot	Treatment	Reaction
M1	20 tons stable manure annually	5.85
C3	Adjacent no-manure plot	5.33
F6	" " "	5.33
M1-1	10 tons stable manure annually	5.60
C3-1	Adjacent no-manure plot	5.27
F5	" " "	5.17 pH
M2	20 tons "Adco" manure annually	5.59
C14	Adjacent no-manure plot	5.25
M2-1	20 tons "Adco" manure annually	5.50
C14-1	Adjacent no-manure plot	5.30

Effect of Lime on Combustion of Tobacco

On three fields at the Windsor station and at Poquonock, liming experiments have been conducted for several years. After fermenting the tobacco from the limed plots and adjacent unlimed plots, the combustion was compared on single leaves and on cigars made from tobacco from these plots. The tests were repeated for three years. (See the station reports for 1927 and 1928 for details.) Results in all cases have uniformly showed that heavy liming has:

1. Reduced the fire holding capacity of the leaves when tested singly (strip test), but
2. When on the cigar the fire holding capacity has been just as good or usually better than for unlimed tobacco.
3. In all cases lime makes the ash white.
4. The coal band is narrower, that is, the burn is closer and less irregular.
5. Too much lime causes the ash to flake.
6. The taste and aroma have been improved.

Altogether then, liming has been beneficial to the burn and the practice is to be recommended as long as the reaction of the soil is sufficiently acid that there is no danger of lime shifting it to a condition favoring root rot. If the soil tests 5.0 pH or below *and combustion is not satisfactory,* lime should be beneficial.

Effect of Liming the Soil on Composition of Tobacco

Tobacco from limed soils thus exhibits characters of combustion which are different from those of tobacco grown on soils which have not been limed. Some of these characters, particularly the whiteness of ash and closeness of burn are desirable; other, such as the "flaking" of ash and reduction in fire holding capacity on the leaf are objectionable. These differences in burn are correlated with changes which liming produces in the chemical composition of the leaf. In order to see to what extent such changes are produced, tobacco (of the crop of 1926) from limed and adjacent unlimed plots—which otherwise were identical in character of soil and previous treatment—was analyzed with respect to those elements which it was belived might be affected by liming. Three different series of plots were used in these analyses as follows:

Limed plots on Field VIII. Beginning with 1922 these plots were limed heavily each year. With the last application in the spring of 1925 they had received during these four years five tons of hydrated lime per acre and the reaction of the soil was slightly above 7.0 pH.

Thielavia series. These consisted of three plots. One half of

each received an application of one ton of hydrated lime per acre each spring, beginning in 1924.

Poquonock field. Plots on this field were limed at the same rate as the Thielavia series, in the spring of 1925 and 1926.

TABLE 5. ANALYSES OF TOBACCO FROM LIMED AND UNLIMED PLOTS. CROP OF 1926. WATER-FREE BASIS.*

Plot No.	Grade	Lime	Total Ash	P_2O_5	K_2O	CaO	MgO	Mn_3O_4	Al_2O_3
			Percentage of minerals						
FIELD VIII									
L	M	Lime	23.89	0.78	6.52	4.72	3.79	.01	.09
L1	M	Lime	23.05	0.73	6.38	4.82	3.58	.01	.08
L2	M	Lime	22.63	0.73	5.92	4.73	4.21	.01	.06
L3	M	Lime	22.90	0.74	6.06	4.79	3.89	.01	.08
L38	M	Lime	23.49	0.75	6.87	4.52	3.61	.01	.11
L39	M	Lime	21.83	1.05	6.37	4.13	3.12	.01	.08
C3-1	M	No lime	26.90	0.85	8.90	5.67	1.16	.10	.09
F6-1	M	No lime	28.15	0.87	8.36	6.55	1.19	.06	.21
N1-5	M	No lime	25.20	0.88	7.51	6.53	1.38	.06	.07
N1-6	M	No lime	25.22	0.93	7.62	6.13	1.29	.07	.07
POQUONOCK FIELD									
4A	All	Lime	24.57	0.77	6.79	4.98	3.11	.03	.17
15A	All	No lime	27.26	0.77	7.23	5.30	1.55	.21	.23
6A	All	No lime	28.19	0.85	7.80	5.84	1.18	.12	.31
THIELAVIA PLOTS									
T1A	M	Lime	22.83	0.72	5.12	5.53	3.49	.01	.08
T1B	M	No lime	24.78	0.84	6.67	6.11	1.56	.29	.14
T1A	S	Lime	25.33	0.62	4.18	6.38	4.54	.02	.11
T1B	S	No lime	27.43	0.76	6.62	7.04	1.57	.28	.31
T2A	M	Lime	23.86	0.82	6.10	5.37	3.13	.01	.05
T2B	M	No lime	24.63	0.84	7.37	5.62	1.18	.04	.11
T2A	S	Lime	25.70	0.60	5.52	6.00	3.15	.02	.14
T2B	S	No lime	26.82	0.75	7.10	6.42	1.18	.04	.13
T3A	M	Lime	23.83	0.69	5.73	5.15	3.58	.01	.11
T3B	M	No lime	25.43	0.85	6.81	6.19	1.62	.06	.06
T3B	S	No lime	27.49	0.68	7.17	6.89	1.59	.09	.17

The lime was not analyzed each year but it was commercial lime from western Massachusetts and unquestionably all of it had some magnesia in it. Some samples from that section have as high as 30 per cent MgO.

Results of the analyses presented in table 5 show that:

1. In every comparison, liming reduced the percentage of total ash, of calcium, phosphorus, manganese and potash. Aluminum was reduced in some cases but not in all.
2. In every case, liming approximately doubled the percentage of magnesium.

*Analyses by E. M. Bailey, Station Chemist.

In experiments with tobacco in Ohio, Ames and Boltz (1) also found that liming a soil reduced the percentage of calcium, potassium, manganese, phosphorus and sulfur but increased the magnesium.

Garner (15) found that magnesium salts are injurious to fire holding capacity of tobacco (more so than the calcium salts). He also found that all magnesium salts produce a white ash.

Apparently the white ash and reduced fire holding capacity which was found on our limed plots are due to magnesium rather than to calcium.

Effect of Lime on Composition of Tobacco from Greenhouse Pots at New Haven

In connection with the greenhouse studies at New Haven which have been described previously, composite samples of both the leaves and stalks from the tobacco grown on various combinations of fertilizer and lime were analyzed by the station chemist for certain constituents. The results are shown in table 6.

Table 6. Analyses* of Tobacco from Greenhouse Pots. Composite of 23 Connecticut Soils. Second Crop, 1928. Water-free Basis.

			Leaves Percentage of			
Treatment	Ash	CaO	MgO	Mn_3O_4	P_2O_5	K_2O
N	27.85	8.13	1.82	.21	.71	2.67
NP	25.08	8.28	2.08	.42	.77	1.57
NPK	25.36	6.78	1.71	.44	.57	4.98
LN	27.14	10.96	1.35	.07	.56	.94
LNP	27.46	10.96	1.15	.01	.85	.76
LNK	28.65	9.01	1.29	.02	.60	3.34
LPK	27.12	10.35	.96	.01	.65	2.20
LNPK	26.11	10.58	.94	.01	.57	1.85

			Stalks Percentage of			
Treatment	Ash	CaO	MgO	Mn_3O_4	P_2O_5	K_2O
N	15.42	2.85	.67	.02	.88	5.08
NP	10.49	1.93	.64	.05	.67	2.97
NPK	11.65	1.03	.29	.03	.55	5.54
LN	12.82	3.97	.65	tr.	.64	2.83
LNP	13.13	4.78	.60	.00	.72	1.56
LNK	13.71	2.16	.37	.00	.58	5.18
LPK	8.98	1.81	.22	.00	.57	2.90
LNPK	7.61	1.83	.21	.00	.44	2.33

An inspection of the data shows that the effect of lime, when applied to acid soils in the form of pure calcium carbonate (containing no magnesium) has been to very materially reduce the con-

*Analyses by E. M. Bailey, Station Chemist.

tent of potash, to slightly decrease the content of magnesium and to materially increase the content of calcium in all the comparisons where other fertilization has been the same. The increased content of lime in the tobacco from the limed pots may appear to be contradictory to the results at Windsor, where lime did not produce an increase in the calcium content of the plant, but materially increased the magnesium content.

However, it must be recalled that a magnesian limestone was the source of lime in the Windsor experiment.

A striking difference between unlimed and limed tobacco, as shown by the analysis of the plant, has been the presence of considerable maganese in the unlimed tobacco, while liming has practically eliminated this element from the plant. This is in complete accord with the Windsor results and is evidence that the poor production of tobacco on highly acid soils is associated with both a high concentration of manganese in the soil and plant.

Regulating the Soil Reaction for Tobacco

From all the data which have been accumulated during this investigation it is apparent that for the majority of soils in this section the optimum reaction is between 5.00 and 5.6 pH. The fact that *some* fields with a reaction as high as 6.00 or as low as 4.6 are producing satisfactory crops is probably due to the modifying influence of other factors which are not discussed here. It is also true that some fields which have the optimum soil reaction are not producing satisfactory crops—showing that soil reaction is by no means the only factor which determines the suitability of a field for tobacco.

The practical question to the grower then is: How can he keep his soil permanently within the optimum? If it is already optimum, how can he keep it from changing to an unfavorable higher or lower reaction? If it is too low (too acid) or too high (not acid enough) what measures can he adopt to correct it?

A certain amount of regulation can be accomplished by proper selection of the fertilizer materials. As indicated by the preceding statements, the effect of each of the ordinary tobacco fertilizer materials is fairly definitely established now. If the grower finds his soil to be near the upper limit of the optimum range, or above it, he should avoid the liberal use of any materials which tend to make it more alkaline and rather favor those with an acid tendency. In this connection, however, he should be cautious about the too liberal use of sulfate of ammonia, which of all the materials, has the most pronounced acidifying power, but which appears to have an adverse effect on combustion (see reports of the Tobacco Station for 1927 and 1928). If the soil tests near the

lower limit of the optimum range, or below it, he should favor the materials with an alkaline tendency.

It will be observed, however, that most of the materials produce only very slight changes in the soil. If the field is *very much* too acid or too alkaline the effects of fertilizers are too slight and too slow; other more effective methods must be used.

If the soil is too acid, the remedy is simple: It may be corrected by applications of lime materials (limestone, burnt lime or hydrated lime). It does not seem to make much difference which of these is used as long as the actual amount of oxides of calcium and magnesium is the same and when they are ground to the same degree of fineness. Unless the soil is very acid (4.5 or below) the equivalet of 1000 lbs. per acre of limestone should be a sufficient amount to apply at one time. Below 4.5, the application may be doubled. If later tests show that the soil is still too acid, the treatment may be repeated after a year or two. Wood ashes is also a good material to use on the more acid soils.

However, when a soil has become too alkaline—usually due to a too liberal application of lime or ashes—and black root-rot has become troublesome, it is not a simple or easy matter to reduce it to the proper degree of acidity. Frequently it will be more profitable for the farmer to use this field for other crops for several years before raising tobacco there again. Due to the leaching of the alkaline elements these soils naturally become gradually more acid. Also during this period the root-rot fungus becomes less prevalent in the soil and this disease will be less troublesome when tobacco is raised again there.

Finely ground sulfur, or "inoculated sulfur", has sometimes been used to make the soil more acid. Experiments with this material in comparison with sulfate of ammonia are now in progress on three tobacco farms and a preliminary report is given in the Tobacco Station report for 1928 (4). Although it has been much more effective than sulfate of ammonia on the soils tested, it is too early to recommend its use since no determination of its effect on the quality of the tobacco has been made yet.

Aluminum sulfate is also being tested and appears promising but the tests have not progressed to a point where recommendations can be made.

In acidification experiments at the Massachusetts Station, Doran (13) used a number of mineral and organic acids and was able to increase both the soil acidity and yield of tobacco with sulfuric, nitric and phosphoric acid. Sulfur had the same effect.

As yet, none of these rapid acidifying agents have been used on a large scale in a practical way.

Summary

A review of investigations in most of the tobacco growing sections of the United States and Canada show that lime has rarely produced material increases in the tobacco crop in field experiments, and that in some cases there is an injury from the use of lime, which is ascribed to the greater prevalence of black root-rot on the limed soils. Most of these field experiments have not given careful consideration to the degree of acidity which exists on the unlimed soils.

A study of methods for the determination of soil acidity as a factor in tobacco production in the Connecticut Valley has shown that there is a close correlation between pH values as determined by both colorimetric and electrometric (quinhydrone electrode) methods and the Jones lime requirement results, when the modifying effect of texture and organic content of the soil are properly evaluated. Correlation factors for various textural classes of different organic contents have been computed.

Over two thousand tobacco fields have been surveyed for soil reaction and the results of several hundred representative cases have been tabulated to determine the frequency occurrence of different degrees of soil acidity (pH values), as well as the character of tobacco grown at these reactions. A soil reaction of between 5 and 5.4 pH is of most frequent occurrence. There is a range between 3.9 and 8.2 pH, with a mean value of about 5.4 pH.

Tobacco fields between reactions of 4.8 and 5.6 pH have been found to produce the highest percentage of satisfactory crops. Below 4.8 the degree of acidity becomes an adverse factor, while above 5.6 pH the injurious effects of black root-rot are in evidence and there is some indication that even in the absence of black root-rot tobacco may be somewhat affected in an adverse direction by conditions of very slight acidity, neutrality or alkalinity.

Very acid soils - below 4.8 pH - have shown increased growth of tobacco when lime is added to a complete fertilizer treatment, in greenhouse experiments. In the field, on a very acid soil, producing poor tobacco even when liberally fertilized, tobacco has been much improved by applications of lime and superphosphate. On extremely acid soils, the injurious effects may be due to toxic manganese, alumium, or both.

Various fertilizers produce different effects on the reaction of the soil. Ammonium sulfate is conspicuous in increasing acidity, while nitrate of soda is the most effective in producing higher pH values (decreased acidity). Urea has a slight acid tendency and the effects of the organic ammoniates are probably very slightly in the acid direction. Manure and all the common carriers of phosphorus tend to decrease the acidity. Carbonate, sulfate and

nitrate of potash have produced little or no effect on soil reaction under field conditions.

Analyses of tobacco from unlimed and limed soils show that lime decreases the percentage of potash and manganese and that where magnesian limestone is used, there is an increase in the content of magnesium with a decrease in the calcium content. In pot experiments a pure calcium carbonate form of lime has increased the calcium content of the plant, with a slight reduction in the magnesium content.

Liming acid soils in experiments at Windsor has improved the character of the burn and the whiteness of the ash.

When soil conditions are too acid for satisfactory results, in case of tobacco at pH values below 4.8 pH, lime in some form is the cheapest and most effective means of reducing soil acidity.

Soils which are at an unsatisfactory reaction from the standpoint of black root-rot can be corrected to some extent by selecting acid-producing fertilizers, although reactions above 6.0 pH are difficult to change sufficiently in a short time, by any practical means now at hand. Further investigations concerning methods of making black root rot soils more acid are in progress.

Recommendations

Since the soil reaction is an important factor in the production of high grade cigar-leaf tobacco in Connecticut, it is desirable that the grower keep himself informed by means of soil tests as to the soil reaction conditions on his tobacco fields.

If the soil is at reactions between 5.0 and 5.6 pH, no lime should be used, and fertilizers tending to diminish the soil acidity should be used with caution. On soils testing below 5 pH the use of fertilizers tending to increase acidity should be avoided, while on many soils between 5.0 and 4.6 pH the occasional use of not more than 1000 lbs. per acre of agricultural limestone or its equivalent in other forms of lime should correct the too acid soil conditions which are present. Soils below 4.6 pH may be safely limed at the rate of 2,000 lbs. per acre, although on excessively sandy soils lighter applications should suffice. The soil should be tested the following year and if still too acid, more may be applied.

Fields with reactions above 6.0 pH are not safe for tobacco, and should be put in other crops until an acidity indicated by reactions of 5.8 or below can be developed through leaching and crop removal, with a consequent loss of lime and other basic materials from the soil.

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Connecticut Agricultural Experiment Station
New Haven, Connecticut

The Thirty-Third Report on FOOD PRODUCTS and the Twenty-First Report on DRUG PRODUCTS

1928

Food and Drug Inspection and Related Work

By
E. M. BAILEY

The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to other applicants as far as the editions permit.

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CONTENTS AND SUMMARY

Material	Page	Sampled by or Submitted to		Total	Adulterated, below standard, or otherwise illegal
		The Station	The Dairy and Food Commissioner		
FOODS					
Carbonated Beverages, etc.	814	0	152	152	19
Catsup	815	1	0	1	0
Cereal Products	815	1	0	1	0
Coffee, etc.	815	1	6	7	2
"Diabetic", Special and Miscellaneous foods	816	39	0	39	...
Eggs and Egg Products	820	5	3	8	1
Fats and Oils:					
Butter	821	0	66	66	1
Oleomargarine	821	0	1	1	1
Lard	822	4	16	20	0
Olive Oil	823	0	27	27	6
Fruits and Fruit Products:					
Sweet cider	823	0	4	4	0
Orange juice	823	0	1	1	0
Dried fruits	823	0	13	13	...
Preserves	824	0	55	55	0
Honey	825	0	1	1	0
Ice Cream, etc	825	0	275	275	2
Maple Products	825	1	1	2	0
Meat Products	825	4	8	12	6
Milk and Milk Products:					
Market Milk	827	17	277	294	35
Chocolated Milk	827	0	2	2	...
Cream	827	6	0	6	0
Cream, canned	827	0	1	1	0
Milk, canned	827	0	1	1	0
Human milk	827	2	0	2	0
Paprika	829	2	9	11	0
Tea	829	14	0	14	0
Vinegar	831	14	10	24	0
Miscellaneous	831	25	0	25	...
Total for foods	...	136	929	1065	73

Material	Page	Sampled by or Submitted to		Total	Adulterated, below standard, or otherwise illegal
		The Station	The Dairy and Food Commissioner		
DRUGS					
Aspirin tablets	832	0	12	12	1
Barbital, etc.:					
Tablets	833	0	5	5	0
Soluble barbital	833	0	3	3	0
Phenobarbital tablets	833	0	1	1	0
Belladonna	833	0	6	6	1
Cinchona	834	0	9	9	5
Colchicum	834	0	4	4	2
Ferric chloride	835	0	18	18	2
Hydrastis	836	0	2	2	0
Hydriodic Acid, diluted	836	0	4	4	1
Hydriodic Acid, Syrup of	836	0	8	8	0
Ipecac	837	0	3	3	1
Lead Subacetate	837	0	4	4	0
Magnesium Citrate	837	0	27	27	21
Mercurial Ointment	839	0	17	17	0
Nitrous Ether, Spirit of	839	0	24	24	14
Nux Vomica	841	0	5	5	3
Stramonium	841	0	1	1	0
Strontium Salicylate	841	0	3	3	0
Witch Hazel Water	841	9	14	23	5
Zinc Chloride	842	0	2	2	2
Zinc Oxide Ointment	842	0	12	12	0
Total for drugs	...	9	184	193	58
MISCELLANEOUS					
Proprietaries, etc	843	0	3	3	1
Tobacco	844	14	0	14	...
Materials examined for poisons, etc	847	20	20	40	...
Water analyses (State Water Commission)	848	6	0	6	...
Total for miscellanecus	...	40	23	63	1
Total for all	...	184	1136	1320	133
Babcock Glassware and Thermometers	848	2746	0	2746	22

The Thirty-Third Report on Food Products and the Twenty-First Report on Drug Products

Food and Drug Inspection and Related Work

By E. M. Bailey

The Station is charged with the administration and enforcement of the fertilizer law; with the administration, but not the enforcement, of the feeding stuffs law and the insecticide law; and, jointly with the Dairy and Food Commissioner, with the administration of the food and drugs act; but enforcement of the last named act rests with the Commissioner. The analytical work required by these statutes is done in the Department of Analytical Chemistry of the Station. In addition special statutes impose other obligations upon this department, notably the responsibility for certification of Babcock glassware and dairy thermometers and for cooperation with the State Water Commission in such analytical work as our facilities permit. Moreover, a considerable amount of work is done each year for the Storrs Experiment Station, and for the last few years the laboratory has collaborated rather extensively in the tobacco investigations being carried on by our own station at Windsor. The department is further required to prepare three annual reports covering the regular inspections of fertilizers, feeding stuffs, and foods and drugs as well as reports, not at fixed intervals, upon insecticides. During the past year a fairly comprehensive compilation of analyses of insecticides, fungicides, bactericides and weed killers has been issued, and other special bulletins are issued from time to time.

The work summarized in this report is that done for the year 1928 for purposes of food and drug control as required by the Dairy and Food Commissioner, and other work of a similar nature closely related thereto which is of public interest. The chemist in charge has continued to serve as a consultant to the Council on Pharmacy and Chemistry of the American Medical Association; as a member of the Executive Committee and of the Committee on Recommendations of Referees of the Association of Official Agricultural Chemists; and as a member of the (Federal) Joint Committee on Definitions and Standards for Foods.

The cooperation of the staff of this department in carrying on the work herein reported, as well as that reported elsewhere, is gratefully acknowledged.

FOODS.

Carbonated Beverages.

Of one hundred and fifty-two samples of carbonated beverages examined for the Dairy and Food Commissioner, sixteen samples contained artificial color, or flavor, or both, the presence of which was not declared upon the labels. One sample was found to contain saccharin; one contained visible dirt, and one bore misleading statements on the label. In no case was the minimum sugar content of 5 per cent not met.

Table I. Misbranded or Adulterated Beverages.

No.	Product	Dealer (Not necessarily the manufacturer)	Remarks
38771	Lemon and lime soda	*Bridgeport:* Berkshire Bottling Works	Undeclared artificial color.
38770	Orange soda	Coco-Cola Bottling Co	Undeclared artificial color.
38765	Orange soda	Hallett Mineral Water Co	Undeclared artificial color.
38763	Orange soda	*Danbury:* R.F. Baker Co., Inc.	Undeclared artificial color.
38960	Lemon, lime and juniper soda	*Hartford:* Boston Branch Groc. Co.	Undeclared artificial color.
38699	Grape soda	Pequot Spring Water Co.	Undeclared artificial flavor and color.
38698	Grape soda	United Bottling Works	Undeclared artificial flavor and color.
38046	Strawberry soda	*Middletown:* Coco-Cola Bottling Works	Undeclared artificial flavor and color.
38038	Lemon and lime soda	*New Britain:* Spring Bottling Works	Undeclared artificial color.
38042	Lemon and lime soda	*New Haven:* Clancy Bottling Works	Undeclared artificial color.
38755	Cherry soda	Elm City Bottling Works	Saccharin present.
38658	Lime soda	*New London:* Nutmeg Club Beverage Co.	Undeclared artificial color.
38690	Ginger ale soda	*Pawcatuck:* Gordon's Market, Mfr. Turk's Head Beverage Co., Prov., R. I.	Visible dirt.
38681	Birch beer soda	*Stamford:* Corbo Spring Water Co	Undeclared artificial color.
38680	Lemon and lime soda	National Spring Water Co	Undeclared artificial color.
38775	Lemon and lime soda	*Thompsonville:* Superior Mineral Water Co	Misleading declaration on label.
38017	Lemon and lime	*Waterbury:* Diamond Bottling Corp.	Undeclared artificial color.
38018	Strawberry soda	Diamond Bottling Corp.	Undeclared artificial flavor and color.
38033	Strawberry soda	*Willimantic:* Hosmer Mt. Spring Bottling Works	Undeclared artificial flavor and color.

In one instance a product was labelled "Imitation Orange Soda" but it contained artificial color with no label declaration to that effect. It is held that the ingredients which give to a product its artificial character should be stated and in this case therefore the declaration of artificial color should not be omitted.[1]

[1] State Regulation 18, p. 21, 1927.

A label on lemon and lime soda, No. 38775, bore a statement to the effect that the contents of the bottle (1 quart), was equal to 308 calories of solid food or seven pounds of oysters. This statement is substantially correct so far as calorie equivalents are concerned but it is misleading in that soda water, in which the solids are practically all sugar, cannot be reasonably compared with oysters, or any other food in which there are other nutrients such as protein, or fat, or both. Calories measure energy production which is only one type of food value.

Catsup.

One sample of catsup, Elizabeth Park Brand made by S. Vogel Sons, Hartford, Conn., was analyzed as follows:

No.	9815
Total solids	35.99%
Water-sol. solids	34.70
Ash	4.00
Salt (NaCl)	2.92
Salt-free ash	1.08
Protein (Nx6.25)	1.88
Fiber	0.47

Cereal Products.

One sample was examined, No. 8346. This was Roman Meal manufactured by the Roman Meal Corporation of Buffalo, N. Y. and Tacoma, Wash.

The product is said to be a natural laxative because of the bran present and is claimed to contain wheat, rye, bran and deodorized and tasteless flaxseed.

The ingredients claimed were found to be present; but the odor and taste of flaxseed was still evident.

The analysis is as follows:

Moisture	6.30%
Ash	4 10
Protein (Nx6.25)	17.31
Fiber	5.43
Carbohydrate (other than fiber)	61.23
Fat	5.63

Coffee.

Seven samples of coffee or modified coffee were examined.

40732 and 40920. Roma Brand Perfect Blend Coffee, Roma Coffee Co., Hartford, Conn. Both of these samples were found to contain an admixture of chicory which was identified by microscopic examination. The samples contained 1.03 and 1.04 per cent of caffeine respectively which indicated that chicory did not exceed 10 per cent of the mixture.

There is no objection to the sale of a mixture of this sort provided such is sold under a label which declares the true character of the product. Under the above label this product is adulterated and misbranded.

41266, Coffee, purchased at the Piggly Wiggly store in West Haven was not found to be adulterated.

9523, 39831 and 39834. Sanka Coffee, 97 per cent of caffeine removed. Sanka Coffee Corporation, New York.

One of these samples, 9523, was purchased by the Station agent and the others by the Dairy and Food Commissioner. The caffeine content found was 0.05, 0.07 and 0.03 per cent respectively. Assuming 1.2 per cent as a fair average caffeine content for coffee the indicated caffeine removal varies from 94 to 97.5 per cent which fairly substantiates the manufacturer's claim.

Sample 9523 was examined in more detail as follows:

Ash	4.20%
Water-sol. ash	3.48
Water-insol. ash	0.72
Soluble solids	20.68
Petroleum ether extract	15.09
Caffeine	0.05

39832. Kaffee Hag, Kaffee Hag Corp., owned and operated by the Kellogg Co., Battle Creek, Mich.

This product is likewise claimed to have had 97 per cent of the caffeine removed. Our analysis showed 0.07 per cent present. This product examined in this laboratory on five occasions from 1915 to 1925 showed caffeine ranging in amounts from 0.03 to 0.10 and averaging 0.06. The per cent removed depends upon caffeine content of the original coffee, but on a basis of 1.2 per cent for ordinary coffee the manufacturer's claim is fairly substantiated.

Special and Miscellaneous Foods.

Thirty-nine samples of this class of foods have been examined and the analyses are given in Table II.

Of the Cellu products, 8334 and 8335, the composition of the Soy Bean flour indicates that about one-half of the oil of the original beans has been removed. Soy Bean Crisps have substantially the composition of the entire bean.

The Diet Rite Products Company have taken over the business formerly conducted by the Woman's Baking Company of Boston. The "fat" in these products is largely mineral oil as previous analyses have shown. Mineral matter (ash), is now considerably lower than formerly possibly due to a change in formulas.

The Energen products are labelled showing the amounts of protein, fat and carbohydrate per unit of food and these statements are substantially correct as shown by our analyses. The products

in general show large amounts of carbohydrate which must be classed as "available" (starch plus soluble carbohydrate). Agar-Bran Biscuits are relatively low in protein and the carbohydrate is probably very largely unassimilable. Energen Protein Food is low in carbohydrate but the high protein is a potential source of a considerable amount of glucose in digestion.

Loeb's Dietetic Bran Wafers and Starch-free Bran are both low in that part of the carbohydrate which may be regarded as available. Microscopic examination reveals only traces of starch present. A sample of Aerated Gluten Bread, submitted by a purchaser, shows about the same composition as other samples of this product previously examined.

In a previous report[1] an analysis of Thomas Gluten Bread is given. This was the name under which the sample was submitted. but the manufacturer questioned the identity of the product and suggested that the sample was, no doubt, their Protein Bread and not their Gluten Bread. To verify this a sample of one of these products was secured in the market by our station agent and a sample of each of them was later submitted by the manufacturer. From the analyses of these samples it appears that the product which we examined a year ago was in fact the protein bread and not the gluten product as stated in our report.

Diaban Dietetic Flour varies somewhat from the composition shown by our previous analysis of this product,[2] but the difference is not greater than would probably occur in manufacturing practice over a period of time.

Jeru Artichoke Flakes are prepared from Jerusalem artichokes by slicing, and cooking in oil. The carbohydrate is chiefly inulin and the result reported as inulin in our analysis is based upon the reducing sugar obtained upon a 15 minute hydrolysis at which time, in our experience, the maximum reducing power is reached. On longer hydrolysis reducing sugars diminish, probably due to the destruction of levulose.

The advantage of inulin feeding in cases of diabetes has been the subject of extended inquiry on the part of students of this disease. A recent paper by Carpenter and Root[3] describes some convincing experiments.

Diaetei Primar Mehl submitted by a physician is said to be a German product used in diabetic dietaries.

A sample of canned fruit (in tins) was submitted by Dr. E. P. Joslin of Boston. The fruit is variously known as "Bakapple", "Bake-apple berry" or "Cloudberry". It resembles our raspberry and its botanical name is *Rubus chamaemorus*. The plant is found in the peat bogs of the far north even within the Arctic Circle. It is found in northern Europe, Asia and North America. In this country it occurs only as far south as Maine in the east and British Columbia in the west.

[1] Conn. Exp. Sta. Bull. 295, p. 312, 1927.
[2] Conn. Exp. Station Bull. 276, p. 342, 1925.
[3] Archives of Internal Medicine, Vol. 42, p. 64, 1928.

TABLE II. ANALYSES OF SO-CALLED DIABETIC, SPECIAL AND MISCELLANEOUS FOODS.

No.	Manufacturer and name of product	Water	Ash	Protein	Fiber	Carbohydrate other than fiber		Fat
						Starch + soluble	Undetermined	
		%	%	%	%	%	%	%
	Chicago Dietetic Supply House, Chicago, Ill.							
8334	Cellu Soy Bean Flour	6.43	6.20	45.00	4.05	11.19	17.42	9.71
8335	Cellu Soy Crisps	1.40	6.85	46.06	5.38	7.00	13.38	19.93
	Diet Rite Products Co., 440 Huntington Ave., Boston, Mass.							
573	Lemon cookies	3.80	1.48	4.38	20.70	45.67		23.97
574	Anise cookies	5.20	3.11	8.69	9.25	48.03		25.72
575	Vanilla cookies	4.60	1.80	4.63	19.65	47.73		21.59
576	Bran, washed	4.53	1.17	13 63	17.20	2.50	55.50	5.47
577	Bran muffins	7.05	3.42	10.50	13.78	61.74		3.51
578	Carraway cookies	5.33	2.76	9.75	9.53	48.89		23.74
579	Cocoa cookies	4.78	2.84	9.13	7.80	44.55		30.90
580	Spice cookies	5.78	2.84	7.50	10.03	51.71		22.14
581	Soup wafers	3.53	6.69	4.25	15.85	45.16		24.52
	Energen Foods Co., 261 Broadway, N. Y.							
8220	Energen Biscuits, Endobran	3.18	3.00	16.13	6.35	20.63	24.64	26.07
8221	Energen Biscuits, Digestive	3.80	1.47	22.75	0.45	38.25	4.96	28.32
8222	Energen Starch-reduced Rolls	4.13	0.89	37.94	0.65	44.69	3.05	8.65
8223	Energen Wheat Meal Bread	4.39	0.95	41.44	1.00	41.00	3.14	8.08
8224	Energen Biscuits, Agar-Bran	4.64	5.03	15.13	10.18	8.00	52.84	4.18
8225	Energen Bread, Batons	4.28	0.64	39.63	0.35	47.44	1.24	6.42
8226	Energen Rusks	4.70	0.67	39.38	0.58	46.44	2.24	5.99
8227	Energen Bread with Casein	4.77	0.91	45.75	0.35	37.44	4.28	6.50
8228	Energen Gluten Semolina	5.85	0.65	21.75	0.35	68.38	0.42	2.60
8229	Energen Protein Food	6.75	4.46	73.25	0.45	1.19	7.50	6.40
8230	Energen Pastry Flour	7.03	0.58	23.88	0.43	54.38	11.06	2.64
8231	Energen Macaroni with Gluten	6.23	0.96	30.50	0.48	58.01	none	3.82
8232	Energen Bismeal Breakfast Food	5.18	1.33	31.56	1.18	52.88	3.27	4.60

No.	Manufacturer and name of product	Water	Ash	Protein	Fiber	Carbohydrate other than fiber: Starch + soluble	Carbohydrate other than fiber: Undetermined	Fat
		%	%	%	%	%	%	%
	Energen Foods Co., 261 Broadway, N.Y.—Con.							
8233	Energen Tapioca	6.45	0.24	8.50	0.35	83.48	none	0.98
8234	Energen Cocoa with Gluten	4.05	4.86	38.94	3.85	11.33	18.38	18.59
	Loeb's Dietetic Food Bakery, 505 W. 171st St., New York City.							
9402	Dietetic Bran Wafers	7.61	6.04	22.69	12.04	4.88[1]	36.83	9.91
9403	Starch-free Bran	7.47	4.91	18.75	16.75	5.00[1]	40.75	6.37
9883	Aerated Gluten Bread	7.21	1.59	42.86[2]	0.75	34.25	3.22	10.12
	The Pure Gluten Food Co., 90 West Broadway, New York City.							
9399	Hoyt's Gluten Muffin Flour	9.32	6.00	36.71[2]	0.27	40.81	5.75	1.14
9400	Hoyt's Gluten Bread Flour	9.64	6.07	37.45[2]	0.28	40.31	5.35	0.90
9401	Hoyt's Whole Wheat Pancake Flour	10.13	6.78	14.42[2]	1.71	55.94	9.17	1.85
	S. B. Thomas, Inc., Long Island City, N. Y.							
599	Thomas' Protein Bread	39.89	2.33	11.28	....	....	45.14[3]	1.36
978	Thomas' Protein Bread	37.53	2.00	10.42	0.58	....	48.00[4]	1.47
979	Thomas' Gluten Bread	35.49	1.81	30.68	0.37	....	30.17[4]	1.48
	MacDowell Bros., Ogdensburg, N. Y.							
9464	Diaban Dietetic Flour	8.21	6.24	25.00	2.31	34.19	7.64	16.41
	Jeru Artichoke Products Co., Denver, Col.							
9876	Jeru Artichoke Flakes	6.91	3.30	3.79	2.01	35.86[5]	5.29	42.84
	Miscellaneous.							
9875	Diaetei Primar Mehl	9.84	3.88	48.50	0.75	34.13	1.70	1.20
8730	Bakapple,[6] canned	84.24	0.52	1.94	3.33	4.70[7]	4.99	0.28

[1] Starch, trace only.
[2] Factor 5.7
[3] Includes starch and fiber.
[4] Includes starch and soluble carbohydrate.
[5] Reducing sugar after 15 mt. hydrolysis, calc. as inulin.
[6] Also called Bake-apple or Cloudberry.
[7] Total sugar calc. as invert sugar.

Eggs and Egg Products.

Three samples of liquid eggs were submitted by the Dairy and Food Commissioner. Nos. 38616 and 38617 were commercial products and 38618 was freshly broken whole eggs. The question was to determine whether the commercial products were whole eggs or whether they contained excess of white.

The analyses were as follows:

	No. 38616	No. 38617	No. 38618
Ammoniacal nitrogen, mgms. per 100 cc.	3.1	5.5	2.1
Solids	27.96%	27.41%	28.04%
Ether extract	10.47	10.49	10.21
Lipoids	15.31	11.38	13.90
Lipoid P_2O_5	0.40	0.30	0.37
Water-sol. protein nitrogen precipitated by 40% alcohol	0.76	0.77	0.73
Odor	none	offensive	none

Compared with the sample known to be freshly prepared whole eggs the other two samples appear to be whole egg products. The average ether extract in whole egg is about 10 per cent whereas it is over 25 per cent in egg yolk and less than 0.1 per cent in egg white. The average for lipoid P_2O_5 in whole eggs is about 0.36%, and for water-soluble protein nitrogen precipitable by 40 per cent alcohol about 1 per cent.[1]

The high content of ammoniacal nitrogen in sample 38617 indicated a state of decomposition as did also the noticeably offensive odor of the product. Assuming 2.6[2] as about the upper limit for ammoniacal nitrogen in edible eggs of 10 per cent ether extract, sample 38616 showed some evidence of deterioration but no odor was perceptible.

Four samples of dried egg yolk and milk powder mixtures were examined. These samples were submitted by the purchasers from stock bought in quantity for use in ice cream manufacture. While these mixtures were referred to by the purchasers as "egg yolk" or "egg yolk powder" there now appears to have been no misunderstanding on their part as to the character of the mixtures, and we were asked to determine the proportions of egg and milk product in them.

Samples 603 and 604 were submitted by R. F. Worden & Sons, Inc., Waterbury. The first sample represented goods bought from the John Lowe Co. of Brooklyn and the second from the National Kreem Co. of New York City.

Samples 734 and 735 were submitted by the Rider Dairy Co. of Danbury, manufacturer not stated.

[1] Jour. A. O. A. C., 8,614.
[2] U. S. Dept. Agr., Bull. 846, (1920).

The analyses are as follows:

	603	604	734	735
	%	%	%	%
Moisture	4.37	4.22	....	....
Ash	5.20	4.51	4.63	4.53
Total nitrogen	5.32	5.27	5.25	5.11
Ether extract	30.23	36.73	....	....
Lipoids	39.73	46.88	....	....
Lipoid-P_2O_5	1.00	1.23	....	....
Sugar (as lactose)	18.60	13.46	16.93	14.52

The samples contain egg yolk in the approximate proportions of 65 to 75 per cent the remainder being skim milk powder or a similar product.

Fats and Oils.

BUTTER.

Sixty-six samples of butter were examined for the Dairy and Food Commissioner and no serious deficiencies in fat or excesses of moisture were found except in one sample, 37888, which contained 18.3 per cent of water and 77.9 per cent of fat. Butter should contain not less than 80 per cent of fat and not over 16 per cent of water.

The deficient sample was purchased of Andrew Koleskenik, Seymour.

The results of the inspection are summarized as follows:

	Moisture	Fat
	%	%
Maximum	18.3	87.7
Minimum	10.1	77.9
Average	14.5	82.0

OLEOMARGARINE.

One sample of Verco Brand Margarin, 37127, made by the Mayfair Margarin Co., Providence, R. I. was examined for the Dairy and Food Commissioner.

The product was sensibly yellow but no artificial color was found to be present. It was properly labelled as oleomargarine, but the pictorial sign of a coconut tree and coconuts and the declaration that the product contains no lard, oleo oil or any animal oil, thus emphasizing its exclusively vegetable character, was objected to in view of the fact that admittedly a substantial part (10 per cent), of the fatty ingredients is butter fat.

The analysis was as follows:

Moisture	9.60%
Ash	2.65
Casein, Nx6.38	0 84
Fat	87.00

LARD.

Sixteen samples bought for pure lard were examined for the Commissioner. No evidence of adulteration was found in any case. Four samples were collected by the Station for experimental purposes, and one was submitted by a purchaser.

The samples were examined as shown in Table III.

TABLE III. EXAMINATION OF LARD.

No.	Dealer	Butyro-refractometer reading @ 40° C.	M. P. of glycerides, degrees C.	M. P. of fatty acids from glycerides, degrees C.	Halphen test
	Hartford:				
40296	Atlantic and Pacific Tea Co., Main St.....	50.6	64.2	....	faint red
40295	Atlantic and Pacific Tea Co., Park St.....	50.6	64.3	....	faint red
40294	Atlantic and Pacific Tea Co., Washington St..	50.7	64.3	....	faint red
40745	Atlantic and Pacific Tea Co., Park St.[1].....	50.9	64.5	....	faint red
40744	Atlantic and Pacific Tea Co., Lawrence St.[2]...	50.4	64.2	57.5	negative
39945	Atlantic and Pacific Tea Co., Albany Ave. and Chestnut St.....	50.8	....	....	negative
	New Haven:				
40737	A. Cavellero, Oak St....	50.3	63.2	57.0	faint color
40741	Kolligian and Okooman, Orchard St.....	50.5	63.7	56.5	negative
40742	Kolligian and Okooman, Orchard St.....	50.5	63.8	57.2	faint color
40739	Lazar, Harry, Goffe St..	50.7	63.9	57.0	negative
40740	Nederman, A., Goffe St.	50.4	63.8	56.8	trace of color
40743	Terrece, O. S., Bassett St.	50.7	63.7	56.8	faint red
	Stafford Springs:				
40747	Economy Grocery.....	50.6	64.3	....	trace of color
40746	First National Stores, Inc.	50.6	64.0	....	negative
	Suffield:				
40748	Economy Grocery.....	50.7	64.0	....	trace of color
40749	Atlantic and Pacific Tea Co.....	50.6	64.3	....	trace of color

[1] Iodine No. 63.4.
[2] Iodine No. 61.8.

Examination of the crystals obtained by the Belfield test were in nearly all cases typical of lard and no evidence of beef stearine was found. In one sample typical lard crystals were formed and also some of a very different type. The two types were separated and their melting points determined. The figures for each were nearly identical and within the limits for pure lard as were the melting points of the fatty acids obtained from the glycerides.

In many cases the Halphen test gave faint reddish colors. In view of the fact that cottonseed products when fed to animals may impart characters to animal fats which result in a positive reaction by this test, these results are probably not significant as an index of adulteration.

OLIVE OIL.

Twenty-seven official samples of olive oil were examined. Six were adulterated. The adulterated samples are as follows:

No.	Brand, Manufacturer or Dealer	Retailer	Remarks
40709	Titan.....	*Ansonia;* James Phillips	Contained cottonseed oil.
39844	Roma Importing Co., Waterbury.....	Stephen Senecky	Contained cottonseed oil.
38975	Cream Olive Oil, Lucca.	*New Haven;* C. Cavellaro, Oak St....	Contained cottonseed oil.
38664	Blue Star, H & W, Inc., New York.....	E. Rosner, Dixwell Ave.	Contained peanut oil.
40724	Marca Crestena.....	A. Cocco, Washington Ave..	Contained cottonseed oil.
39841	El Toro, Stack Bros.,	*Seymour;* Chas. Plink, New York.....	Contained cottonseed oil.

Fruit Products.

SWEET CIDER, ETC.

Four samples of apple cider were submitted by the Commissioner. They contained from 10.7 to 15.7 per cent of solids. One was preserved with benzoate of soda but in the others no preservative was found. The preserved sample contained 11.12 per cent of solids, 0.57 per cent of ash and 0.59 per cent of acid expressed as malic acid.

A sample of Monquin Brand orange juice labelled as unheated natural juice with cane sugar, and 0.2 per cent benzoate of soda, but without artificial color or flavor, was found to be of the substance and quality stated so far as our examination could discover.

DRIED FRUITS.

In the process of preparing dried fruits the fumes of burning sulphur are employed in order to prevent or diminish discoloration due to oxidation which would impair the marketability of these products.

The limit beyond which sulphur dioxide should not be allowed in food products is a debated question. The regulations in this State raise no objection to this substance in products which by long usage have been prepared with sulphur dioxide provided it is not used to conceal damage or inferiority, such as the marketing of excessive water; and provided the proper label declaration is made. What quantity may be regarded as a menace to health has not been determined and no official limit for sulphur dioxide in foods has been fixed. At one time a limit of 350 milligrams per kilo was proposed.

During the past year thirteen samples of dried fruits were examined for sulphur dioxide content with the results as shown in Table IV.

TABLE IV. SULPHUR DIOXIDE IN DRIED FRUITS.

No.	Manufacturer	SO_2, mgms. per kilo of fruit
	Apples:	
39837	Hartmann Dried Fruit Co., Rochester, N. Y...	47.2
	Apricots:	
40731	Guggenheim & Co., California.....	492.1
40706	Richmond Chase Co., San Jose, California.....	982.4
39849	F. H. Liggett & Co., New York.....	554.3
39835	California Packing Co., San Francisco.....	885.1
39833	Rosenberg Bros. & Co., California.....	1,185.0
40734	Rosenberg Bros. & Co., California.....	1,470.0
40704	C. C. Collins & Co., Santa Ana, California.....	2,152.0
	Peaches:	
40735	R. Fair, Modesto, California.....	1,562.0
40707	Napa Fruit Co., Napa, California.....	299.1
39838	California Peach and Fig Growers' Association, Fresno, Cal.....	1,013.0
39836	R. C. Williams, Inc., New York.....	268.2
40733	Rosenberg Bros. & Co., California.....	1,724.0

A limited amount of data on the sulphur dioxide content of dried fruits is found in a previous report from this laboratory[1] where it appears that the quantity found did not exceed 600 milligrams per kilo. The results obtained now show a wide range of variation, and in view of the fact that about one-half of the samples contain less than 1000 milligrams per kilo (0.1 per cent), amounts of from 50 to 100 per cent more than this would appear to be excessive.

PRESERVES.

Fifty-five samples of fruit preserves were examined for saccharin and preservatives. No saccharin was found and no preservatives were found except in two instances where declaration of benzoate of soda was made.

[1] Conn. Exp. Sta. Report 1912, p. 101.

Honey.

One sample of honey, 40903, was submitted by the Commissioner. It was within the limits of composition for pure honey and was passed.

Ice Cream, Etc.

Two hundred and seventy samples of ice cream were examined. The distribution of samples with report to fat content is shown by the following summary.

Per cent of fat	No. of samples	Per cent of total
8.0 to 9.9	25	9.3
10.0 to 11.9	65	24.1
12.0 and above	178	65.9
7.9 and below	2	0.7

From this data it is seen that about two-thirds of the samples examined contained 50 per cent more milk fat than the minimum specified in our law, viz., 8 per cent. This does not mean however, that two-thirds of the production in the State is of that grade.

FROZEN PUDDING.

Five samples of this type of products were examined. They generally contain less than 8 per cent of fat but are sold under declarations which make them legal products. Regulations require these products to observe the same sanitary measures as are in force for ice cream.

Maple Products.

One sample of maple sugar, 9092, submitted by Daigle Bros., Marion, was examined and not found adulterated.

Analysis:

Moisture 13.28 per cent; ash 0.97 per cent; insoluble ash 0.38 per cent; lead number (Winton), 2.38 per cent; malic acid value 0.58 per cent.

One sample of maple syrup, 37123, St. Johnsbury Pure Vermont Maple Sap Syrup was examined for the Dairy and Food Commissioner and was not found adulterated.

Meat Products.

Eight samples of frankfurt sausage were examined six of which contained starchy material, or color, or both for which proper declaration was not made. This should not be understood to mean that such a large proportion of frankfurts is illegally sold in this State. The explanation is that the inspector takes only those

samples which are suspicious. Iodine tests made by him at the store or factory enable him to avoid the collection of a large number of unnecessary samples.

With proper declaration cereal or starchy material may be used in sausage provided the amount does not exceed 3.5%. Samples not properly branded are listed in the following summary.

No.	Retail dealer (not necessarily the manufacturer)	Remarks
	Forestville:	
38011	The Atlantic and Pacific Tea Co.	Undeclared cereal and color
38012	The Atlantic and Pacific Tea Co.	Undeclared cereal and color
	New Canaan:	
40907	P. Calaluca	Undeclared cereal
	Norwich:	
38013	F. G. Thum	Undeclared cereal
	Torrington:	
38004	O'Meara's Market	Undeclared cereal
	Winsted:	
40914	J. P. Gagner	Undeclared cereal

Two samples were examined for moisture and nitrogen. From these values excess water in sausage can be estimated. It is permissible to use 3 per cent of water or ice in the manufacture of sausage and somewhat more in the case of those types of sausage which are smoked or cooked, but in no case should more water be added than is required to make the products palatable. The ratio of water to protein in the usual cuts of meat which are used in sausage making is about 4 to 1. In one of the samples above mentioned moisture was found to be 54.7% and protein (nitrogen x 6.25), 13.63%, and no added water was indicated. In the other sample 54.5% of water and 14.13% of protein were found which would indicate that not more than 2% of water had been added.

Skimmed milk powder if used in the manufacture of sausage requires a declaration. A sample said to contain about 5 per cent of such powder, and so labelled, was examined; and also a sample of the milk product used. The powder contained 49.5 per cent of sugar, calculated as lactose. The sausage on microscopic examination showed the presence of the milk product and direct reducing sugar was present in the amount to 1.9 per cent which would indicate approximately 4 per cent of milk product in the sausage.

In our report of a year ago[1] it appears that a sample of frankfurts purchased at the Reliable Market in New Haven were manufactured by Chas. Hertler of New Haven. This is the information as it appears on our records made by the inspector at the time

[1] Conn. Exp. Sta. Bull. 295, p. 317, 1928.

and place of sale, but in view of the explanation made by Mr. Hertler and of our further information we are inclined to believe that this sample did not represent a product of his manufacture.

Milk, Milk Products, Etc.

Two hundred and ninety-four samples of market milk have been examined of which 277 were submitted by the Dairy and Food Commissioner and the remaining samples (17), were examined for producers and consumers.

On analysis of 146 official samples the following classification is made:

	No. of samples	Per cent
Not found adulterated	63	43.2
Adulterated by watering	32	21.9
Adulterated by skimming	3	2.0
Below standard:		
in solids and solids-not-fat	32	21.9
in solids and fat	1	0.7
in solids, fat and solids-not-fat	15	10.3
Totals	146	100.0

The list of adulterated samples is given in Table V.

Six samples of cream were tested for fat content; and two samples of human milk were examined for protein and fat.

Two samples of flavored milk product resembling so-called chocolated milk were submitted by the Dairy and Food Commissioner together with a syrup and a powder which were to be used in preparing the drink in the home. The liquids contained 14 and 14.9 per cent of solids respectively with 2.7 and 3.7 per cent of fat, largely milk fat. One sample was evidently made with milk of standard quality while in the other partially skimmed milk was apparently used. The flavor, both syrup and powder, consisted of cocoa, honey and malt and contained 13.5 per cent of protein and 4.9 per cent of fat when calculated to the water-free basis. In the proportion in which the flavor was added to milk (one teaspoonful to a glass of milk), food solids in the beverage would be about 10 per cent more than in the original milk.

A sample of Swiss Sterilized Milk and one of Swiss Cream were submitted by the Commissioner. So far as chemical analyses indicate the products meet the requirements of the standards for milk and cream in this State. The milk is not claimed to have been evaporated. It contains 3.7 per cent of fat and 12.5 per cent of solids. The cream contained 25.1 per cent of fat.

TABLE V. ADULTERATED MILK.

CONTAINING ADDED WATER.

No.	Dealer	Solids	Fat
	Bridgeport	%	%
40407	City Dairy Co.	10.23	3.0
40408	City Dairy Co.	8.94	2.2
40409	City Dairy Co.	10.67	3.1
40410	City Dairy Co.	9.01	2.3
40411	City Dairy Co.	9.83	2.8
40412	City Dairy Co.	10.32	3.1
40413	City Dairy Co.	9.22	2.5
40414	City Dairy Co.	9.49	2.7
40415	City Dairy Co.	9.87	2.6
40416	City Dairy Co.	9.75	2.5
40417	City Dairy Co.	9.51	2.8
40418	City Dairy Co.	9.76	2.8
40419	City Dairy Co.	10.01	2.9
40420	City Dairy Co.	10.37	3.2
40421	City Dairy Co.	10.25	3.1
40422	City Dairy Co.	9.66	2.8
40995	Henry Foland	11.24	3.5
	Danbury		
37756	O. W. Starr	10.76	3.3
	Fairfield		
37758	John Zadny	9.45	2.9
37759	John Zadny	9.45	3.0
	Gaylordsville		
38634	Walter Kilian	10.16	2.9
	Litchfield		
38811	John Walter	11.15	3.9
38812	John Walter	8.86	2.3
38813	John Walter	10.79	4.2
38814	John Walter	10.13	2.9
38815	John Walter	9.36	2.9
38816	John Walter	11.35	3.7
38817	John Walter	10.46	3.3
	New Haven		
38488	Chas. Philips	10.51	3.3
40959	State Dairy Co.	11.28	3.6
	Old Saybrook		
40168	Mrs. Grace Appleby	9.35	3.1
40169	Mrs. Grace Appleby	9.44	3.1

SKIMMED MILK.

	Southington		
39300	B. Yuekiewick	10.83	2.4
39301	B. Yuekiewick	10.48	2.4
	Address Unknown		
39991	Victory Restaurant	10.88	2.1

Spices.

Nine samples of paprika were examined and no evidence of adulteration found. One sample somewhat exceeded the limit for ash, as set by the standard, and another exceeded the limits for total ash and acid insoluble ash. Two samples were examined for experimental purposes.

Tea.

Supplementing a study carried on by Mr. G. F. Mitchell, Supervising Tea Examiner of the United States, to determine the effect of various types of containers upon the keeping qualities of teas, analyses of fourteen samples of tea were made during the past year. Corresponding samples were examined in 1927 and the original teas which formed the basis of the study were analyzed in 1926. A summary of the analytical data is given in Table VI.

It is generally recognized that quality in tea as judged by the expert taster cannot be postulated in terms of definite chemical constituents so far as they have been determined, and the data here given probably reveals no definite and consistent relationship to changes in quality which have been observed by tasting methods. Moreover the proportions of constituents in the leaves are quite different from those in infusions upon which judgment of quality is largely based.

The figures for moisture do not necessarily reflect the moisture conditions in the various packages, but rather that of the teas as prepared for analysis under the atmospheric conditions prevailing at the time. The total ash and the several constants thereof show no variations other than those incidental to analysis and sampling. Total nitrogen and caffeine remain remarkably constant. Variations in fiber are not significant. Results for tannin must be interpreted with some reservation because of the limitations of the method generally employed for its determination, but notwithstanding this the data show a consistent increase in this constituent group as the teas age. The observation of tea tasters that old teas are markedly astringent suggests a possible relation between this quality and the tannin increase shown. It might be questioned whether this relatively small increase in tannin would be reflected in the taste of the infusion; and whether the amount of tannin soluble in water is likewise increased. Materials soluble in petroleum ether decrease somewhat in the teas held for one and two year periods. This decrease amounting to about 50 per cent in the case of green tea appeared to be exaggerated but the value obtained for the original sample (2.82 per cent), was thoroughly checked and is not an abnormal value for green tea. Although total petroleum ether extract decreased, that portion of it which was lost on heating at 110° C showed a slight but consistent increase. An attempt was first made to determine volatile oil by

TABLE VI. SUMMARY OF ANALYSES OF EXPERIMENTAL PACKAGE TEAS

Sample Nos.	Water	ASH						Nitrogen	Caffeine, from N	Fiber	Tannin	Pet. Ether Extract 40 hrs. extraction	Vol. oil; Loss at 110° C, basis of 40 hrs. extraction
		Total	Water-soluble	Water-insoluble	Acid-insoluble	Alkalinity water-sol., cc N acid/100 gms.	Alkalinity water-insol., cc N acid/100 gms.						
	%	%	%	%	%			%	%	%	%	%	%
1926													
Black	5.03	5.21	2.96	2.25	0.07	29.5	34.5	4.20	2.78	9.89	6.16	1.08	0.10
1927													
Black—Maximum	6.28	5.26	3.18	2.35	0.25	32.0	37.5	4.21	2.84	10.48	8.01	1.01	0.20
Minimum	5.68	5.00	2.89	1.98	0.05	30.0	34.0	4.15	2.71	9.06	6.65	0.81	0.14
Average	6.07	5.17	3.04	2.13	0.10	31.3	34.9	4.18	2.76	9.76	7.29	0.90	0.17
1928													
Black—Maximum	7.23	5.83	3.14	2.69	0.14	32.8	40.5	4.22	2.84	10.15	9.35	0.90	0.27
Minimum	6.01	4.99	2.93	2.06	0.05	29.0	35.0	4.06	2.74	9.73	7.97	0.70	0.20
Average	6.61	5.21	3.00	2.22	0.09	30.9	36.9	4.16	2.80	9.93	8.46	0.82	0.22
1926													
Green	3.23	5.53	3.27	2.26	0.20	32.8	31.8	4.37	2.15	11.0	5.87	2.82	0.10
1927													
Green—Maximum	5.65	5.58	3.66	2.18	0.28	36.0	28.0	4.44	2.45	10.61	7.54	1.79	0.24
Minimum	4.11	5.35	3.37	1.92	0.19	34.5	26.5	4.31	2.12	9.77	6.61	1.49	0.20
Average	4.71	5.50	3.50	2.01	0.24	35.4	27.3	4.34	2.21	10.20	7.03	1.66	0.22
1928													
Green—Maximum	5.74	5.43	3.39	2.13	0.32	35.5	30.5	4.38	2.19	11.10	9.11	1.89	0.28
Minimum	4.50	5.32	3.25	1.97	0.17	34.3	27.8	4.26	2.13	10.57	7.20	1.11	0.21
Average	5.01	5.38	3.32	2.05	0.23	35.0	29.1	4.31	2.16	10.78	8.26	1.42	0.25

the tentative method[1] recommended for tea but the results were unsatisfactory. Only minute quantities were obtained even on prolonged distillation. Loss on heating the petroleum ether extract at 110° C suggested itself as affording some measure of the volatile oil, but this procedure is not entirely satisfactory. The results obtained suggest that further study of volatile oil content of tea by more exact methods of measurement might be of interest and value.

Vinegar.

Ten official samples of vinegar were examined for the Dairy and Food Commissioner and all were passed. Fourteen samples were submitted by producers of home made cider vinegar.

Miscellaneous Foods, Etc.

BEMAX.

This preparation made by or prepared for Vitamins Ltd. of London is claimed to be a concentrated extract of natural B vitamin, the detoxicated embryo.

Wheat embryo is a commercial article and a well recognized source of vitamin B. Our sample of Bemax was not unlike commercial wheat embryo in general appearance and character. From the comparative analyses it is evident that the two articles are substantially alike in composition, particularly when compared on the water- and fat-free basis.

Feeding tests revealed no superiority of Bemax over our laboratory sample of commercial wheat embryo. All experimental animals failed on both products when amounts under 300 milligrams daily were fed and 400 milligrams in both cases were required for conspicuous gains.

Analyses are given in Table VII.

Table VII. Analyses of "Bemax" and Wheat Embryo.

	Bemax No. 678		Commercial Wheat embryo No. 679	
	Air dry	Water- and fat-free	Air dry	Water- and fat-free
	%	%	%	%
Water	4.88	....	8.68	....
Ash	5.22	6.09	4.30	5.40
Protein (Nx5.7)	30.44	35.50	24.97	31.36
Fiber	2.45	2.86	2.18	2.74
Nitrogen-free extr	47.63	55.55	48.17	60.50
Fat	9.38	....	11.70	....
Total phosphorus (P_2O_5)	2.87	3.34	2.37	2.98

POTATOES.

Twenty-two samples of potatoes representing different stages of maturity were analyzed after digging in the fall and before planting in the spring. These analyses were made for the Storrs Station and results are for discussion elsewhere.

[1] A. O. A. C. Methods of Analysis, p. 340.

COLLABORATIVE WORK ON CHOCOLATE.

Crude fiber determinations were made on two samples of chocolate in a trial of methods suggested by the A. O. A. C. referee on cacao products. These results appear in the proceedings of the association.

DRUGS.

Aspirin.

Twelve samples of aspirin tablets were examined and the results are given in Table VIII.

Table VIII. Analyses of Aspirin.

No.	Dealer	Mfr.	Aspirin, grains per tablet claimed	Aspirin, grains per tablet found	Free salicylic acid, grains per tablet found
	Clinton				
38995	Allen's Pharmacy,	Davies Rose & Co., Boston	5.0	5.1	none
38996	Neal's Pharmacy,	McKesson & Robbins, New York	5.0	4.9	none
	Cromwell				
39247	Hatchcock Pharmacy,	Hance Bros. & White, Philadelphia	5.0	4.9	0.02
	Devon				
39214	Signor Shoppe,	Aspirin Co. of America, New York	....	5.6	0.02
	Hartford				
39521	State Pharmacy,	Brewer & Co., Worcester	5.0	5.0	trace
	Jewett City				
39515	Chas. R. Carey,	Norwich Pharm. Co	5.0	4.9	trace
	Meriden				
39101	Broderick & Curtin,	A. D. S., New York	....	5.1	trace
	New Britain				
39520	City Drug Store,	Squibbs	5.0	4.8	trace
	Norfolk				
39240	Geo. T. Johnson,	United Drug Co., Boston	5.0	4.7	0.02
	Suffield				
39143	Suffield Pharmacy,	Lilly's	5.0	4.9	0.02
	Torrington				
39205	Collins & Collins,	United Drug Co., Boston	....	4.6	0.02
	Willimantic				
39234	Curran & Flynn,	Albany Chem. Co., Albany, N. Y	5.0	4.7	0.04

In several instances our inspection records do not show the claimed dosage of aspirin but it is presumably 5 grains in each case. Conferences between committees representing manufacturers and Federal control officials have reached the conclusion that good commercial practice justifies a tolerance not exceeding 7.5 per cent above or below the dosage claimed for tablets of this kind. We have heretofore regarded 10 per cent variation as acceptable. All of the products here reported however come within the stricter limit except in one case which is also outside the more liberal tolerance.

Barbital, Etc.

Barbital and soluble barbital are new admissions to the pharmacopoeia. Barbital, sometimes called "veronal", is diethylbarbituric acid, and soluble barbital is the sodium salt of that acid.

Phenobarbital, also newly admitted to the pharmacopoeia, is phenylethylbarbituric acid and is sometimes known as "luminal".

Three samples of soluble barbital were examined and found to range from 99.2 to 99.8 per cent purity. The requirement is not less than 98.5 per cent. The samples were procured at the Halley Pharmacy and Leroy Tucker's drug store in Bristol and at the Case Drug Store in Winsted.

Five samples of barbital tablets, all declared to contain 5 grains of medicament, were analyzed and all were satisfactory, barbital dosages of from 4.7 to 4.9 grains being found. The samples were obtained at the Spaulding Co. and the Branford Drug Store in Branford, the Bridge Pharmacy in Windsor Locks, the Case Drug Store in Winsted, and the Walling Drug Co., Wallingford.

One sample of phenobarbital tablets, ½ grain, was purchased at Miner's Pharmacy in South Manchester and was satisfactory. The tablets contained 0.52 grain of medicament.

Belladonna

Fluid extract of belladonna leaves should contain in each 100 cc not less than 0.27 gm. and not more than 0.33 gm. of the total alkoloids of belladonna leaves.

Tincture of belladonna should contain in each 100 cc not less than 0.027 gm. and not more than 0.033 gm. of total alkaloid of belladonna leaves.

Assays of three samples of fluid extract and three samples of tincture are given in Table IX.

Table IX. Assays of Belladonna.

No.	Dealer	Manufacturer (as stated)	Alkaloids gm/100 cc
		Fluid Extract.	
	Waterbury		
39534	Ebbo Drug Co.....	Norwich Pharm. Co..	0.25
	Willimantic		
39231	J. J. Hickey Drug Co..	Park, Davis & Co....	0.22
39233	Wilson Drug Co.....	United Drug Co.....	0.31
		Tincture.	
	Manchester		
39813	E. J. Murphy.....	Lilly.....	0.025
	Putnam		
39802	E. H. Burt.....	Lilly.....	0.026
	Taftville		
39820	Taftville Pharm.....	Sharp & Dohme.....	0.025

All samples were 90 per cent of respective standards or better, excepting one sample of fluid extract.

Cinchona.

Fluid extract of cinchona should yield not less than 4 gms. nor more than 5 gms. of total alkaloids of cinchona from each 100 cc.

Tincture of cinchona should yield from like volume not less than 0.8 gm. nor more than 1.0 gm. of alkaloids.

Compound tincture of cinchona should yield not less than 0.4 and not more than 0.5 gm. of alkaloids per 100 cc of tincture.

Both samples of fluid extract were below standard, but one of them was within a tolerance of ten per cent.

All of the tinctures obtained were compound tinctures. None of them were within the U. S. P. limits and only three could be passed with a liberal tolerance. Nos. 39538 and 39817 are duplicates from the same source as are also 39540 and 39818. No second samples were obtained in the other cases.

Assays are given in Table X.

Table X. Assays of Cinchona.

No.	Dealer	Alkaloids found gm/100 cc
	Fluid Extract.	
	New Britain	
39519	Egan Pharmacy	3.71
	Rockville	
38972	Crosby's Pharmacy	2.15
	Compound Tincture.	
	Oakville	
39817	Byrnes Drug Co	0.10
39538	Byrnes Drug Co	0.20
	Seymour	
39504	Geo. Smith & Son	0.57
	South Manchester	
39812	Quinn's Pharmacy	0.19
	Waterbury	
39816	Apothecaries Hall Co	0.34
	Watertown	
39818	Post Office Drug Store	0.29
39540	Post Office Drug Store	0.34

Colchicum.

The fluid extract of colchicum should yield from each 100 cc of solution not less than 0.36 gm. and not more than 0.44 gm. of colchicine.

The tincture should yield from 0.036 to 0.044 gm. from each 100 cc.

A sample of fluid extract from the J. H. Lee Pharmacy in Rockville yielded 0.34 gm. of colchicine per 100 cc and was of standard strength. One from the Chatham Pharmacy in East Hampton contained 0.27 gm. and was deficient.

One sample of tincture from Leary's Drug Store in Naugatuck yielded 0.038 gm. colchicine per 100 cc and was of standard quality. A sample from the W. P. Lynch Drug Store in Wallingford yielded only 0.016 gm. and was below standard. A second sample of this stock could not be obtained as the supply was exhausted.

Tincture of Ferric Chloride.

Eighteen samples of tincture of ferric chloride were analyzed. The official preparation should contain not less than 4.48 gms. iron (Fe), per 100 cc of solution.

Two samples showed conspicuous excesses of iron possibly as a result of evaporation of alcohol. The others were reasonably close to the requirements of the standard.

Analyses are given in Table XI.

Table XI. Analyses of Tincture of Ferric Chloride.

No.	Dealer	Iron (Fe), gms/100 cc
	Ansonia	
39507	S. W. Smith & Co	5.25
	Cheshire	
39216	Gladding's Pharmacy	4.78
	Darien	
39114	The Bell Pharmacy	5.60
	Devon	
39213	J. L. Mallard Drug Co	5.55
	Fairfield	
39118	Clampett's Pharmacy	4.25
	Greenwich	
39110	Veandrey & Co., Inc	4.88
	Meriden	
39102	Victor W. Schmalzer	4.78
	New Canaan	
39106	Windt Pharmacy	6.55
	New London	
38987	Downey's Pharmacy	4.79
	New Milford	
39120	Harrison F. Bassett	5.33
	Simsbury	
39149	The Lathrope Pharmacy	4.91
	Stamford	
39107	Chas. S. Finch	5.06
	Stonington	
38980	Conner's Drug Store	5.16
	Thompsonville	
39141	Thompsonville Drug Co	4.98
	Waterbury	
39536	Higgins & Glynn	7.88
39537	Kipp Pharmacy	5.24
	Westport	
39116	The Bridge Pharmacy	5.08
	Willimantic	
39229	The Nathan Hale Drug Store	5.48

Hydrastis.

One sample of fluid extract and one of tincture of hydrastis were examined. The fluid extract should contain 1.8 to 2.2 gms. of ether-soluble alkaloids of hydrastis in each 100 cc. The tincture is no longer a U. S. P. preparation.

The fluid extract, from the Spaulding Co., Branford, yielded 1.86 gms. of alkaloids per 100 cc and was of standard strength. The tincture, from the Boulevard Pharmacy, Bristol yielded 0.32 gm. of alkaloids and was passed.

Hydriodic Acid.

Diluted hydriodic acid should contain not less than 9.5 per cent nor more than 10.5 per cent of hydriodic acid, HI.

In the inspection last year, out of four requests for this article only once did the inspector receive a product of the identity and strength called for. This year better results were obtained. Four samples were taken, three of which were within the limits of the standard and one was a little over 10 per cent over strength. The percentage ranged from 9.5 to 11.8.

Samples were taken at the following drug stores:

Town Hill Pharmacy (11.8%), Starr Bros., Inc. (10%), Nichols & Harris (10.2%), all of New London, and Claxton's Pharmacy (9.5%), of Torrington.

Syrup of Hydriodic Acid.

Syrup of hydriodic acid should contain not less than 1.3 mg. and not more than 1.5 gm. of hydriodic acid (HI), per 100 cc.

Eight samples were examined and all were within the limits of the standard with the exception of two which were reasonably close to the minimum.

Analyses are given in Table XII.

Table XII. Analyses of Syrup of Hydriodic Acid.

No.	Dealer	Hydriodic Acid HI, gms/100 cc
	Deep River	
39241	LaPlace Pharmacy	1.3
	Derby	
39543	Blume's Pharmacy	1.2
	New London	
38991	Nichols & Harris	1.4
	Rockville	
38973	Vincent's Pharmacy	1.5
	Saybrook	
38992	Watson's Drug Store	1.4
	Winsted	
39238	F. S. Bunnell	1.3
39236	Opera House Pharmacy	1.2
	Westbrook	
38994	Neidlinger's Pharmacy	1.4

Ipecac.

The fluid extract of ipecac should yield from 1.35 to 1.65 gms. of ether-soluble alkaloids per 100 cc of solution.

A sample from Callahan's Drug Store, New London, yielded 1.24 gms. per 100 cc. One from Notkin's Pharmacy, Waterbury yielded 1.80 gms. Another from the Bristol Drug Co. of Ansonia yielded 0.79 gm. None of the preparations were within the prescribed limits but the last named sample was notably deficient.

Solution of Lead Subacetate.

This solution should contain lead subacetate equivlaent to not less than 18 per cent of lead (Pb).

Four samples were examined and were found to equal or exceed this limit or to be within a reasonable tolerance of the standard. The analyses showed percentages ranging from 17.7 per cent to 24.4 per cent.

Samples were obtained from W. J. Dumphy, Waterbury; Central Drug Co., Bristol; J. J. Cody, New Canaan; and the Service Drug Co., Meriden.

Solution of Magnesium Citrate.

The Pharmacopoeia requires that this preparation contain magnesium citrate corresponding to not less than 1.5 gms. of magnesium oxide (MgO), in each 100 cc of solution. Additional specifications require not less than 3.33 gms. of free citric acid and not less than 9.81 gms. of total citric acid in 100 cc.

An experimental sample prepared according to the directions given in the U. S. P. showed that these standards can easily be met or closely approximated.

	Experimental sample	Standard
Free citric acid	3.31	3.33
Total citric acid	9.65	9.81
Magnesium oxide	1.73	1.50

In several instances the inspection samples bore labels showing that they were made according to the 9th revision of the pharmacopoeia instead of the 10th to which there is no objection if the composition of the product conforms to the standard indicated by the label.

One product was labelled as "Aperient Magnesia". Our law permits substandard drugs to be sold provided their substandard character or true strength is indicated. Since "aperient" means "laxative" or "purgative" and applies to a standard product as well as to a substandard one, the term is not sufficiently descriptive. The label should bear the further statement "not a U. S. P product" or words of similar effect.

Of twenty-seven samples examined, four met or substantially equalled the requirements of the standard and two others met the U. S. P. IX as their labels indicated. All other samples were deficient in one or more particulars although many of them met the major requirement as to content of magnesium oxide.

Analyses are given in Table XIII.

TABLE XIII. ANALYSES OF SOLUTION OF CITRATE OF MAGNESIA.

No.	Dealer	Free citric acid, gms/100 cc	Total citric acid, gms/100 cc	Magnesium oxide, MgO, gms/100 cc
	Derby			
39545	Harding Drug Store.....	2.56	8.36	1.58
39544	Hotchkiss Pharmacy.....	1.72	7.02	1.42
	East Hampton			
39245	The Barton Drug Co.....	2.73	8.58	1.64
	Fairfield			
39119	Randall's Pharmacy.....	2.37	6.87	1.16
	Guilford			
39132	Frank E. Douden.....	3.19	9.07	1.54
39130	Monroe's Pharmacy.....	0.26	4.68	1.03
	Milford			
39212	A. H. Botsford.....	2.25	7.89	1.51
39210	Milford Pharmacy.....	2.10	7.93	1.62
39209	John T. Howes.....	2.81	7.74	1.45
	Manchester			
38968	North End Pharmacy.....	1.89	4.87	0.71
	New Hartford			
38953	Marble's Pharmacy.....	4.10	8.72	1.21
	New London			
38986	E. Callahan's Drug Store..	2.88	9.03	1.74
	New Milford			
39121	Harison T. Bassett.....	2.77	7.21	1.20
	Norwich			
39127	W. D. Ricker.....	3.15	8.38	1.46
	Plantsville			
39217	F. J. Hallahan.....	2.72	7.52	1.27
	Rockville			
38971	J. H. Lee.....	3.20	8.73	1.51
38969	Est. F. E. Metcalf.....	2.16	6.64	1.20
	Seymour			
39506	The Corner Drug Store....	1.88	6.97	1.39
	South Manchester			
38965	Packard's Pharmacy.....	2.30	8.07	1.74
38961	Magnell Drug Co.....	2.02	6.24	1.12
	Stonington			
38979	Burtch's Drug Store.....	3.16	9.25	1.62
	Stafford Springs			
39227	E. H. Wicks, Est.....	3.39	9.41	1.65
	Torrington			
38958	North End Drug Store....	1.81	6.43	1.22
	Union City			
3 500	E. J Sodlosky	1.82	7.63	1.57
	Windsor			
39147	Charles E. Paxson.....	2.83	8.70	1.69
	Winsted			
38956	The Case Drug Store.....	3.82	9.67	1.64
	Place Unknown			
39136	.....	2.47	8.54	1.72

Mercurial Ointment.

Mercurial ointment, stronger, contains not less than 49 per cent and not more than 51 per cent of mercury (Hg).

Mild mercurial ointment contains not less than 29 per cent and more than 31 per cent of mercury (Hg).

Four samples of the stronger preparation and thirteen of mild ointment were examined and all found to be within the limits for the official preparations or reasonably close to the minimum requirements.

Analyses are given in Table XIV.

Table XIV. Mercurial Ointment.

No.	Dealer	Mercury %
	Stronger.	
	Essex	
39242	W. H. Pond	49.47
	New Britain	
39518	Packard Drug Co	49.08
	New Canaan	
39104	Rinyon's Pharmacy	49.11
	Willimantic	
39230	Wilson's Windham Pharmacy	47.34
	Mild.	
	Bristol	
39529	Madden Drug Store	29.50
	Canaan	
39239	Freeman Dempsey	29.00
	Collinsville	
39201	McNamara's Pharmacy	29.87
39202	Valley Pharmacy	29.16
	Meriden	
38999	Palace Pharmacy	29.44
	Naugatuck	
39502	Olson's Drug Store	29.32
	New Milford	
39122	Park Pharmacy	30.17
	Shelton	
39546	Mahoney's Corner Drug Store	29.63
	Suffield	
39142	Suffield Pharmacy	28.89
	Torrington	
38959	North End Drug Store	29.29
	Westport	
39117	The Westport Drug Co	30.24
	Willimantic	
39232	Bay State Drug Co	28.93
	Windsor Locks	
39144	R. J. Keefe	30.86

Spirit of Nitrous Ether.

This preparation is a solution in alcohol and should contain not less than 3.5 per cent and not more than 4.5 per cent of ethyl nitrite.

More than one-half of the twenty-four samples examined were below standard. These deficiencies are no doubt largely due to lack of necessary precautions in preserving the solution after it is made. The pharmacopoeia emphasizes that this product should be kept in "small, well-stoppered dark amber-colored bottles, in a cool, dark place, remote from fire."

Analyses of inspection samples are given in Table XV.

TABLE XV. ANALYSES OF SPIRIT OF NITROUS ETHER.

No.	Dealer	Ethyl nitrite %
	Ansonia	
39509	McQuade's Corner Drug Store	3.48
	Essex	
39243	Veales Drug Store, Inc	1.99
	Guilford	
39131	Frank E. Douden	3.07
39129	Monroe's Pharmacy	1.76
	Madison	
39128	Monroe's Pharmacy	2.83
	Manchester	
38967	E. J. Murphy	3.90
	Meriden	
38998	N. P. Forcier	3.38
	Milford	
39211	Primrose Drug Store	1.81
	Mystic	
38981	Mystic Pharmacy	2.94
	New London	
38983	James Drug Store	2.82
38984	The Moon Pharmacy	3.39
	Norwich	
39516	Central Ave. Pharmacy	1.56
	Saybrook	
38993	A. L. James	2.78
	Seymour	
39505	The Seymour Pharmacy	0.08
	South Manchester	
38966	Packard's Pharmacy	3.52
	South Norfolk	
39115	Newbauer's Drug Store	3.75
	Stafford Springs	
39228	D. H. McCormick	3.74
	Stamford	
39108	The Church Pharmacy	3.13
	Stonington	
38978	Burtch's Drug Store	0.08
	Thompsonville	
39139	O'Brien's Pleasant St. Pharmacy	2.08
	Torrington	
39204	Opperman's Drug Store	4.26
	Wallingford	
39549	F. W. Marx	2.99
	Winsted	
39237	Bannon's Drug Store	4.42
39235	The City Pharmacy	3.18

Nux Vomica.

Tincture of nux vomica should yield from each 100 cc not less than 0.237 nor more than 0.263 gm. of alkaloids of nux vomica.

Five samples were examined. None were within the U. S. P. limits noted above but two were within 10% of the minimum required and three were from 16% to 24% under the minimum.

Assays are given in Table XVI.

Table XVI. Assays of Nux Vomica.

No.	Dealer	Nux Vomica alkaloids gm/100 cc
	Bridgeport	
39218	Schines Pharmacy	0.18
	Naugatuck	
39503	Naugatuck Drug Co	0.20
	Shelton	
39815	E. J. Bordin	0.22
	Thompsonville	
40701	Steele's Corner Drug Store	0.20
	Torrington	
39206	Thourlough's Pharmacy	0.21

Stramonium.

Tincture of stramonium should yield not less than 0.0225 and not more than 0.0275 gm. of alkaloids of stramonium from 100 cc.

The one sample examined was obtained from the Sisson Drug Co., Hartford, and was of standard quality. It yielded 0.0230 gm. of alkaloid.

Strontium Salicylate.

Two samples of strontium salicylate were tested and both found to be of standard quality. Both were over 99 per cent pure.

The samples were obtained from J. H. Quinn & Co., So. Manchester and from Edw. Prouty, Windsor.

A sample of strontium salicylate tablets, 5 grain, was obtained from Metcalf's Drug Store, East Haven, and passed as satisfactory. They contained 4.5 grains of strontium salicylate per tablet.

Witch Hazel.

Distilled extract of witch hazel or witch hazel water should contain not less than 14 per cent of alcohol by volume and, among other specifications, should not show the presence of denaturing substances such as wood alcohol, diethylphthalate, etc.

Fourteen official samples were examined. Of nine taken from various druggists all being the product of the Connecticut Chemical and Disinfectant Co. of New Haven, five were considerably under the required alcoholic strength due, as was later determined, to faulty methods of checking alcohol content in the

factory. No denaturants were found except in one sample which showed a trace of diethylphthalate. The remaining samples representing products of the Dickenson Co. of Essex, Pond's Extract Co. of Clinton, and the Williams and Carleton Co. of Hartford were all passed.

Nine unofficial samples were also tested in a comparative study of methods for detecting denaturants.

Zinc Chloride Solution.

Solution of zinc chloride is an aqueous solution containing not less than 48.5 per cent nor more than 52.0 per cent of zinc chloride, $ZnCl_2$.

Two samples were obtained, one from the Boswell Drug Co. and one from the Greenwich Drug Store, Inc., both of Greenwich. Both samples were below standard. They contained 35.1 per cent and 36.9 per cent of zinc chloride respectively.

Zinc Oxide Ointment.

Zinc Oxide ointment should contain about 19.8 per cent of zinc oxide assuming zinc oxide to be of U. S. P. purity—viz. 99%.

Samples examined are listed in Table XVII.

All were passed as satisfactory.

Table XVII. Analyses of Zinc Oxide Ointment.

No.	Dealer	Zinc oxide, ZnO %
	Canaan	
39125	Farnum's Drug Store	18.6
39124	The Service Pharmacy	19.4
	Cheshire	
39215	Edson N. Sperry	19.9
	Darien	
39113	Lombardi Drug Store	21.0
	Forestville	
39523	Kent's Pharmacy	20.4
	Pawcatuck	
38977	Higgins' Pharmacy	19.5
	Portland	
39246	Conklin's Pharmacy	20.0
	Simsbury	
39200	Hoffert's Pharmacy	20.0
	Thomaston	
39207	Doyle's Drug Store	20.2
39208	G. A. Lemmon	20.3
	Waterbury	
39532	R. E. Holmes	20.3
	Watertown	
39539	D. G. Sullivan	19.2

Proprietaries, Etc.

"VINDOR DIABETIC WINE."

This preparation was made by the Zarol Medical Research, West Haven, Conn.

Analysis:

> Sp. Gr. 20° C. 1.0106; solids 10.92 gms/100 cc; ash 1.07; extract (calc.) 9.46; acidity, as tartaric acid 0.74; invert sugar 0.38; sucrose trace; iron and aluminum trace; calcium oxide 0.26; phosphoric acid (P_2O_5) 0.56; P_2O_5 in ash 0.40; total nitrogen 0.02; alcohol by vol. 17.74%. Sodium glycerophosphate (calculated from P_2O_5) 2.48. Aloes, quinine, glycerophosphates and saccharin present.

The label on the product stated, in part, that this wine "is a powerful tonic and nerve restorative highly recommended by leading physicians for diabetes, wasting diseases," etc.; and further, in part, "a valuable auxiliary in the treatment of diabetes and an aid in the disappearance of sugar in the urine."

Direct claims of curative properties were not made but the language was such as to convey the impression to the consumer that curative or mitigative effects were to be expected in cases of the disorders mentioned, whereas the substances contained in medicine are not recognized by authoritative opinion as likely to produce such results. The manufacturer of the article at a hearing before the Dairy and Food Commissioner readily agreed to thoroughly revise their label to omit false and misleading declarations and this has now been done.

SLENDS.

This is said to be "a delicious medicated gum". Made by Slends, Inc., New York.

The gum is in the form of pink, sugar coated lozenges with wintergreen flavor. Phenolphthalein equivalent to 1.2 grains per tablet was found but no alkaloids were found and no vegetable extractives were identified.[1]

ASPERGUM, DILLARD'S.

This product is made by the Health Products Corp., Newark, N. J., who are also the makers of Feen-a-mint, "the chewing laxative".

Aspergum is an orange flavored gum containing aspirin in the amount of about 3.5 grains per tablet according to our analysis.

The label on the package makes it plain that aspirin is present and directions are given for its use. The declaration is further made that the product is "a medicine not a confection". Under these circumstances it seems clear that the article must be classed

[1] See Jour. Am. Med. Assoc. 87, 1665 (Nov. 13, 1926) and 89, 138 (July 9, 1927) for other reports on Slends.

as a drug, yet so far as can be judged by the ordinary sense of taste Aspergum is merely a chewing gum with a delicious orange flavor—a very acceptable confection. The rather indiscriminate use of aspirin, as such, is prevalent enough and regarded with disfavor by medical authorities, and it seems unwise and even dangerous to encourage its unrestricted use by dispensing it in such a palatable form.

It is true that many bitter or otherwise unpleasant drugs are frequently masked by added flavors or by chocolate or other palatable coatings, but in all such cases the medicinal character of the finished product remains evident to the taste, or the form of the article still suggests a medicine rather than a confection. Moreover there is not the same objection to the disguising of simple medicaments, such as certain laxatives, for example, that there is to the same practice in the case of more potent drugs.

Tobacco.

In a previous report analyses of a number of brands of tobaccos of reduced nicotine content were given and for comparison the nicotine content of ordinary tobaccos was given based upon analyses made in this laboratory and upon some cited from the reports of other analysts. This work attracted some interest on the part of physicians and others and during the past year further analyses of tobaccos of both types have been made. For convenience the data already published together with additions made later are summarized in Table XVIII.

Through the courtesy of the Carl Henry Co. a sample of pipe mixture of reduced nicotine content and a sample representing the same tobacco prior to the nicotine-reducing process were examined thus affording direct evidence of the extent to which nicotine is removed. Without such data conclusions as to nicotine removal are necessarily based upon averages accepted as fairly representative of unprocessed leaves of various types and grades. Nicotine, basis of air-dry tobacco, was found as follows:

	Total nicotine	"Free" nicotine
Before treatment, No. 1861.....	2.09%	0.16%
After treatment, No. 1862.....	0.98%	trace

Table XVIII. Nicotine Content of Some Tobacco Products. (Air Dry Basis)

Pipe Tobacco.	Total nicotine %	"Free" nicotine %
Ordinary (unprocessed)		
Black Bass (chewing and smoking).	2.46	....
BL Light Plug.....	2.62	....
Blue Boar.....	1.45	0.33
Craven Mixture.....	2.84	0.28
Gilbert's Mixture.....	2.09	0.45
Hudson's Bay Imperial Mixture...	1.95	0.13
Lucky Strike Plug.....	1.76	....

TABLE XVIII. NICOTINE CONTENT OF SOME TOBACCO PRODUCTS. (Air Dry Basis)—*Continued*

	Total nicotine %	"Free" nicotine %
PIPE TOBACCO.		
Ordinary (unprocessed)		
Main Brace Cut Plug	1.29	....
Old English Curve Cut	1.94	....
Prince Albert	1.82	....
Tuxedo	2.22	....
Maximum	2.84	0.45
Minimum	1.29	0.13
Average	2.04	0.30
So-called "denicotinized"		
Dormy (Cestrada)	2.26	0.28
Henry, Carl	0.98	trace
O-Nic-O	0.97	0.21
Sackett	0.98	0.18
Maximum	2.26	0.26
Minimum	0.97	trace
Average	1.30	0.17
CIGARS		
Ordinary (unprocessed)		
Evermore	1.82	1.36
Judges Cave	1.80	0.79
Knickerbocker (Osterweis)	1.62	0.75
Knickerbocker (Osterweis)	1.90	0.60
King Perfectos	0.91	0.37
Manilla	1.31	0.72
Partagas, Habana	1.38	1.11[1]
Reyes de Espana	1.16	0.79
Rosedale	1.53	0.37
Seven-Twenty-Four	1.64	....
Maximum	1.90	1.36
Minimum	0.91	0.37
Average	1.51	0.76
So-called "denicotinized"		
Girard	1.54	....
Haddon Hall[2]	1.39	0.67
Henry, Carl	0.99	0.26
Henry, Carl	0.61	0.19
Henry, Carl	0.62	0.19
Sackett	0.67	0.18
Sano	0.87	....
Maximum	1.54	0.67
Minimum	0.61	0.18
Average	0.95	0.30

[1] pH value 7.8

[2] Our information is that these cigars were bought as "low in nicotine". It is not known that they are actually advertised as "denicotinized".

TABLE XVIII. NICOTINE CONTENT OF SOME TOBACCO PRODUCTS. (Air Dry Basis)—*Continued*

CIGARETTES.	Total nicotine %	"Free" nicotine %
Ordinary (unprocessed.)		
Benson and Hedges	1.26	0.17
Camel	2.21	0.42
Capstan Navy Cut	2.30	0.26
Chesterfield	2.53	0.45
Condax	1.06	....
Egyptian	1.59	....
Egyptian Arabs	1.35	....
Egyptian Deities	1.28	0.15
Egyptian Luxury	1.60	....
Egyptienne Straights	1.45	....
Fatima	2.79	....
Fifty-six	1.43	....
Hassan	1.94	....
Helmar	1.56	....
Home Run	1.89	....
Home Run	1.67	....
Home Run	1.78	....
La Lucbana	0.43	....
Lucky Strike	1.88	0.41
Makaroff	1.21	....
Marlboro	1.94	0.37
Mecca	2.17	....
Melachrino	1.31	0.11
Mogul	1.45	....
Mogul	1.52	....
Murad	1.52	....
Nebo	2.03	....
Nebo	1.93	....
Old Gold	2.17	0.43
Omar	1.98	....
Pall Mall	1.38	0.14
Phillip Morris	1.48	....
Phillip Morris	1.40	0.17
Piedmont	2.89	0.37
Piedmont	3.34	....
Rameses II	1.73	....
Richmond Straight Cuts	2.79	....
Royal Nestor	1.47	....
Schinasi	1.51	....
Sweet Caporal	2.05	....
Sweet Caporal	2.85	....
Tareyton	1.75	....
Turkish Trophies	1.44	....
Toro, Porto Rican	1.06	0.37
Toro, Porto Rican	1.08	0.45
Zubelda	1.97	....
Maximum	3.34	0.45
Minimum	0.43	0.11
Average	1.77	0.31

TABLE XVIII. NICOTINE CONTENT OF SOME TOBACCO PRODUCTS. (Air Dry Basis)—*Concluded*

CIGARETTES	Total nicotine %	"Free" nicotine %
So-called "denicotinized".		
Cestrada, Virginia	2.10	0.33
Dormy Blue Ribbon Turkish	1.19	0.15
Dormy Red Ribbon Turkish	1.19	0.19
Henry, Carl	0.95	0.16
Nestor Lord (Lord Nestor Gianaclis)	0.92	0.11
O-Nic-O	1.14	0.20
O-Nic-O	0.73	....
O-Nic-O	0.95	....
Sackett	1.07	0.20
Sackett	1.07	0.13
Sackett	0.97	....
Sano	0.79	0.11
Maximum	2.10	0.33
Minimum	0.73	0.11
Average	1.09	0.18

MISCELLANEOUS DRUGS, ETC.

The following materials, nine in number, have been examined for the Dairy and Food Commissioner, health officers or other officials interested.

37129. *Essence of Anice.* Said to have been sold as such but analysis did not show it to be the article demanded. It contained no determinable amount of oil of anise, 17.3% of alcohol, 56.9% of solids, and 49.5% of sugar. Petroleum ether extract was colorless and crystalline (anethol?). Preparation may have been the elixer of anise but was not the essence or spirit of anise.

37133. *Kelloids.* (*F. J. Kellogg & Co.*) One grain tablets with sweetish taste. Mineral (ash) 10.35%, sugars 66.6%. Magnesium, sodium and potassium present in ash. Starch present. Iodine, alkaloids, phenolphthalein or vegetable cathartics not detected. Other medicament, if present, not identified.

7713. *Medicine for Turkeys.* Brown-white powder with odor of orris root. Starch grains resembled orris root starch. No ipecac detected. Borax or boric acid present. Sample appeared to be orris root with small amount of boric acid. No other medicament found.

9659. *Paint, Liquid.* Found pigment 59.7%, vehicle 40.33%. Pigment contained 61.2% basic lead carbonate and 35.2% of zinc oxide. Guaranteed pigment 60%, vehicle 40%. Pigment, 59% basic lead carbonate, 39% zinc oxide and 2% tinting materials.

3509. *Painters' Savogan.* Moisture 10.06%, ash 82.82%; total fatty acids 7.94%; free fatty acids 0.25%; sodium carbonate 79.79%. Calculated composition: water 10.06%, sodium carbonate 79.79%; soap as sodium stearate 8.28%; free fatty acids (as oleic acid) 0.25%; undetermined 1.62%.

8293, 8322. *Prescription.* Prescription called for 1/10 mgm. (1/650 grain), of atropine sulphate per capsule, with sodium salicylate and acetphenetidine. Atropine sulphate found was approximately 1/12 grain per capsule, a dosage which is within the range regarded as dangerous. A second lot compounded on the same prescription was found to contain 1/110 grain which is in excess of the amount called for, but within the limits of safety. One capsule of the larger dosage produced alarming symptoms but the patient recovered.

8875. *Prescription.* Medicine prescribed for a dog. Nux vomica was among the ingredients and symptoms of strychnine poisoning were noted. Approximately .024 grain per capsule was found. Two capsules had evidently been administered, equivalent to about 1/20 grain of strychnine. The effect of this dosage would no doubt depend upon the size and condition of the animal. The usual dosage (for humans) is 1/12 to 1/60 grain.

8129. *Spring water.* Residue from evaporation of 20 quarts of spring water, source Hazardville, Conn. Wt. of solids 1.5 gms. equivalent to 75 p.p.m. in original water. Solids chiefly calcium and magnesium combined as carbonates and sulphates. Appears to have no unique value medicinally. (See Conn. Food Report 1900 p. 201 for discussion of Connecticut spring waters.)

Other Miscellaneous Materials, Examined for Poisons or Other Injurious Substances.

Thirty-one other samples, chiefly instances of suspected poisoning of domestic animals, have been examined but do not require individual discussion or comment. These examinations were made largely for the Commissioner on Domestic Animals or for local authorities charged with similar supervision. Some have been made also for the Dairy and Food Commissioner, for local Health officers and for individuals.

State Water Commission.

Six samples of trade waste liquors from manufacturing plants in the State have been examined in considerable detail and reported to Mr. Copeland, sanitary engineer to that Commission. This work is done by statutory provision which enlists the collaboration of this Station when desirable.

Babcock Glassware, Etc.

The following tabulation summarized the work done under the statutes providing for the checking of glassware which is to be used in carrying out the Babcock test upon milk and cream and the checking of thermometers which are to be used for the control of pasteurization temperatures.

	Accurate	Rejected	Total
Babcock glassware, test bottles and pipettes	2561	13	2574
Thermometers	163	9	172

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Bulletins

OF

Immediate Information

Numbers 62 to 67

Bulletin of Immediate Information No. 62

March 1, 1929

Connecticut Agricultural Experiment Station

New Haven, Connecticut

The Control of the Asiatic Beetle in Lawns

R. B. Friend

The Asiatic beetle (*Anomala orientalis* Waterhouse) in its grub stages is a serious enemy of lawns. In the Westville section of New Haven and

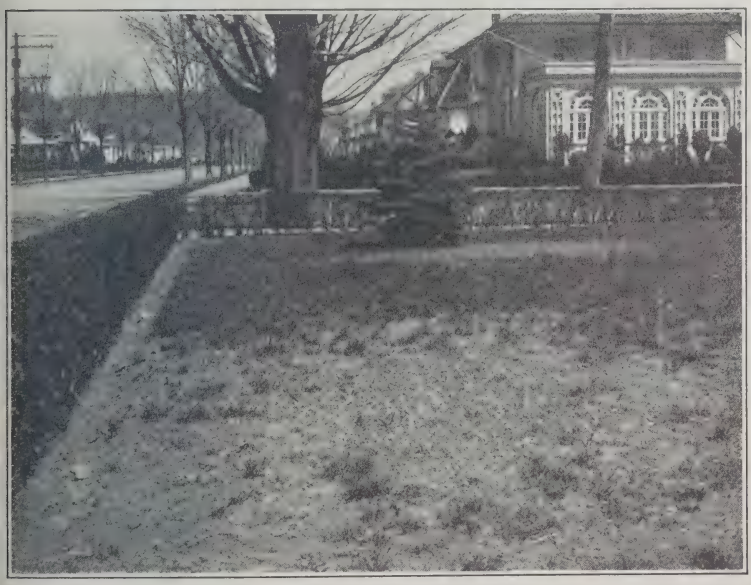

Figure 1. Lawn on McKinley Avenue, showing injury by grubs.

in a small region of West Haven upwards of 200 lawns have been injured to such an extent that the grass has been killed over all or part of the property. In certain instances, the owners have remade their lawns two or three times at great expense. The larvae of this insect are probably

present in greater or less numbers in all lawns in the infested territory, whether the grass is killed or not, and the best means of control as yet known entail the use of the right insecticides applied in the proper manner. It is the purpose of this bulletin to give brief information regarding the pest and directions for treating the lawns to protect them against future attack by the larvae according to the best methods devised thus far.

LIFE HISTORY AND HABITS

The eggs are laid in the soil, from three to nine inches below the surface, during July and August (Fig. 2). They hatch in 24 to 28 days, and the

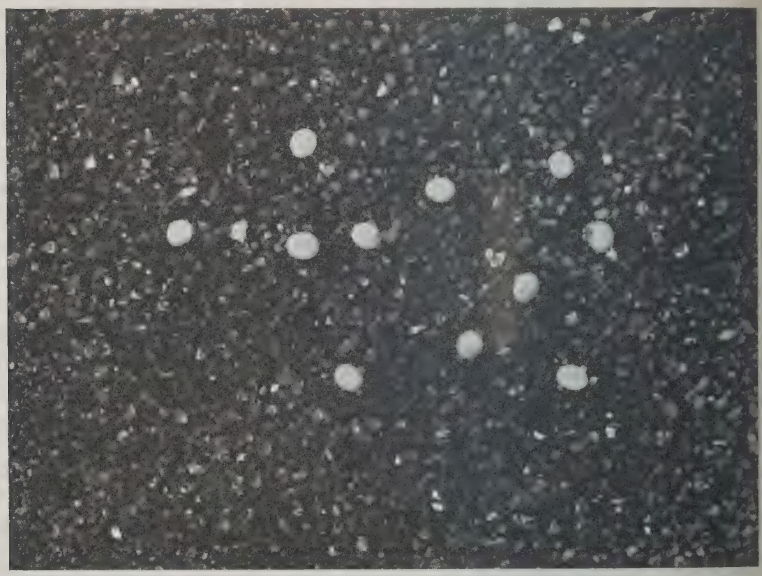

FIGURE 2. Eggs. Enlarged four times.

young larvae come close to the surface of the ground to feed on the dead organic matter and living grass roots found there. These larvae are about one-sixth of an inch in length when first hatched, but they grow to a length of about one inch before pupating. In appearance they are very similar to the larvae of the May beetle, called white grubs, but are smaller (Fig. 3). If at all numerous, they eat the grass roots to such an extent that the plants are killed and a large part or all of the lawn may turn brown in September (Fig. 1). An examination of the lawn at this time will reveal the partly grown larvae in the top inch of soil. About the middle of October the larvae begin to go more deeply into the soil to hibernate, and by the middle of December there are none to be found near the surface. Hibernation usually occurs at a depth of between ten

and fifteen inches. About the last of April, the larvae come up close to the surface and resume feeding, but at this time of the year the grass is usually in a vigorously growing condition and the feeding of the larvae is not so extensive as during the previous fall; hence, the spring injury to the lawns is not so great. During the first part of June the larvae go down into the soil to a depth of three to nine inches and remain quiescent about a week. During this time they do not move about in the soil, but remain in one place and by moving the abdomen back and forth hollow out a cell in which pupation takes place (Fig. 4). The pupal period which follows immediately lasts about two weeks, and adult beetles begin to emerge from the soil the last of June.

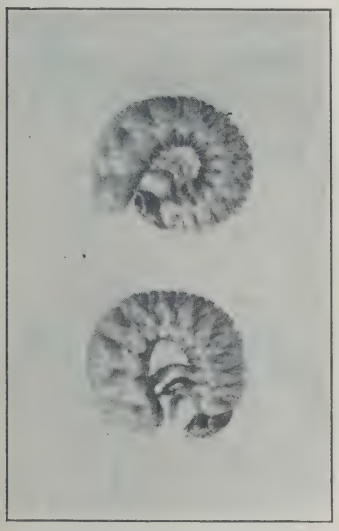

FIGURE 3. Fully grown grubs. Enlarged twice.

FIGURE 4. Pupa in cell in earth. Natural size.

Most of the adults are found during the month of July, although they occur during August and a few may be found the first part of September. They feed to a slight extent on the petals of various flowers and are quite common on roses, although the injury they cause is negligible. Much of the adult life is spent in the ground, and the beetles are frequently found occupying burrows about an inch deep. They fly very little and then for short distances only. This may account for the slowness with which the insect is spreading from the original center of infestation. These beetles are about three-eighths of an inch in length and vary in color from pure black to almost entirely straw (Fig. 5). Most of them have black marks on the thorax and wing covers, the ground color being straw, and the marks on the wing covers characteristically U-shaped.

TREATMENT OF LAWNS

In order to prevent injury to lawns when this insect is present, it is necessary to kill the larvae before they reach the destructive stage in August and September. This may be accomplished by the use of arsenate of lead or carbon disulfide emulsion without injury to the grass, if the proper precautions are taken. The arsenate of lead gives better results and is more safely handled, for the carbon disulfide emulsion is not only very explosive, but will injure the grass if carelessly applied.

Lawns may be treated with arsenate of lead any time except during the cold winter months when there is frost in the ground, but if the treatment is delayed until after the first of August the grass may be severely

FIGURE 5. Color variation of the adults. Enlarged about three times.

injured by the insects. It is essential, therefore, that all treatment be completed by this time if arsenate of lead is used.

PROTECTION OF LAWNS NOT SEVERELY INJURED

If the grass in the lawn is in good condition and it is desired to protect it against future injury, arsenate of lead should be applied before August 1. Mix three pounds of arsenate in about twelve gallons of water for each 100 square feet. Put the necessary amount of water in a barrel or other suitable container and stir in the required amount of lead arsenate. As this material settles fairly rapidly in water, the mixture should be thoroughly stirred frequently to keep it uniform. Sprinkle this over the lawn slowly and evenly so that it soaks in without running off or collecting in pools. Before the poison dries on the surface of the ground or the grass, the area should

be sprinkled in the same manner with about the same amount of water in order to wash the poison into the soil. This treatment may be conveniently made with a garden watering can.

If the lawn slopes so that water runs off or collects in pools, the arsenate of lead should be mixed with a small amount of very slightly moist (not wet) earth and this should be spread evenly over the surface. Use the same amount of arsenate for the same area as above.

Re-making of Lawns in which Grass is Killed

If the grass has been killed by the larvae, it is advisable to turn over the soil in order to get rid of weeds and ensure a good turf. After this is done, smooth the ground with a rake and apply two pounds of lead arsenate evenly over each 100 square feet. In order to get an even distribution of poison, the arsenate should be applied by sifting through a 14-mesh screen, but if a wind is blowing, it is best to mix it with a small amount of very slightly moist earth and spread this mixture over the ground. After the poison is spread, it should be worked into the soil to the depth of one inch with an iron rake. The ground may then be smoothed and seeded.

Where the infestation of larvae is not too heavy, a good control might be effected by raking over the infested area in the spring, seeding it and then, after the grass is growing well, applying lead arsenate in water in the manner described above. There is, however, the likelihood that the larvae will kill off the grass before it gets a good start and that weeds will crowd out the lawn grasses.

The lawn should be treated with lead arsenate in water as above described for a distance of about five or six feet around the area in which the grass was killed. One treatment with arsenate of lead should last several years, according to the experience of Federal entomologists in controlling the Japanese beetle which has similar habits, although experiments with the Asiatic beetle have covered one season only. If the lawn slopes very steeply, so that it must be re-turfed with sod, the sod should be treated with a suspension of lead arsenate in water in the manner described above a few weeks before being used. Cut the poisoned sod into sections and lay in the usual manner.

Use of Top-Dressings

When it is desirable to top-dress the lawn with loam, enough arsenate of lead should be mixed with the top-dressing to be equivalent to two pounds for each inch of loam covering an area of one hundred square feet. If one-fifth of one inch of top-dressing is applied, the appearance of the lawn will not be marred, and this may be repeated as often as the growth of the grass will permit, about once every seven or eight weeks, until a total of five applications has been made. The result will be about one inch of poisoned soil on the surface of the lawn at the end of the treatments. Each of these five applications will require six ounces of lead arsenate in 2,880 cubic inches (= 12.5 gallons or 1.34 bushels) of loam. If the entire inch of loam is to be placed on the lawn at once, two pounds of lead arse-

nate should be mixed with 8.3 cubic feet of loam for each 100 square feet of lawn surface. This is slightly less than one-third of one cubic yard of loam. The arsenate and loam may be conveniently mixed by placing the latter on a smooth wood or concrete floor in a layer about six inches deep, spreading the arsenate evenly over the top of this layer, and then shoveling the whole over four or five times. The arsenate should be sifted through a fine screen (such as used for windows) before using.

Use of Carbon Disulfide

Carbon disulfide emulsion may be obtained in the concentrated form which contains 70 per cent carbon disulfide. There has lately been placed on the market a miscible carbon disulfide of the same strength but with superior keeping qualities, not being injured by cold weather or long storage, to both of which the emulsion is very susceptible. Both of these insecticides are very explosive and must be kept away from hot pipes, fires and so forth. Both must be diluted 200 times with water and applied to the infested area at the rate of three pints of diluted material per square foot of surface. This should kill all larvae which are within two or three inches of the surface when the treatment is made. The soil should not be extremely dry nor yet full of water. The application should be made the latter part of August. The material must be applied to the lawn so slowly that it does not run off and does not collect in pools. The former condition will result in a poor kill of larvae and the latter condition will kill the grass. Since the carbon disulfide tends to evaporate rapidly from the diluted material, the nozzle of the sprinkling device must be held close to the ground. A common garden watering can may be used for small areas. For large areas special apparatus is desirable. The use of this material requires some experience if good results are to be attained, and its effect is but temporary, since no poisonous material remains in the ground after a few days.

FERTILIZING AND SEEDING

Fertilizer should be applied to the lawn after the arsenate has been on at least a week and after the grass is growing well if the area has been reseeded. There is some danger of injury to the grass if the fertilizer and arsenate are applied at the same time. Any good lawn fertilizer not too high in phosphoric acid is suitable. Ammonium sulfate is also safe. This, as well as a complete fertilizer, has been used in our experiments.

The grass mixtures commonly sold in New Haven for seeding lawns give a good turf on arsenated soils if the soil is fertile. It is best to seed rather heavily. The germination of the seeds may be retarded somewhat by the insecticide, but no other effect has been noted.

IDENTIFICATION OF LARVAE

There are many species of white grubs which very closely resemble the larvae of the Asiatic beetle in appearance. If any doubt exists as to the identy of beetle larvae found in a lawn, specimens may be sent to the Connecticut Agricultural Experiment Station for determination.

Bulletin of Immediate Information No. 63

April 1, 1929

Connecticut Agricultural Experiment Station

New Haven, Connecticut

The European Corn Borer

A Menace to Corn, Vegetable and Garden Plants

W. E. Britton

INJURY TO CROPS

The European corn borer, *Pyrausta nubilalis* Hubn., has a dirty white larva an inch or less in length marked with scattered black dots. It

Fig. 6. A sweet-corn patch in eastern Massachusetts heavily infested with borers. The stalks are so weakened by the feeding of the borers that they soon break over. (After Mass. Dept. of Agriculture.)

tunnels all through the stalks and ears. It first injures corn, especially sweet corn, and may cause such economic damage that the crop cannot be grown with profit. When heavily infested, the stalks soon break down as shown in Fig. 6. After the corn has become thoroughly infested, the borers may enter celery, rhubarb, bean, beet, dahlia, gladiolus, chrysanthemum, aster, zinnia, and other cultivated herbaceous plants and many of the larger weeds. In New England there is danger that the borers of the two-brooded area may be transported in the stalks of vegetables and certain kinds of cut flowers, and therefore these materials are included in the quarantine regulations.

PRESENT CONDITIONS IN CONNECTICUT

During the season of 1928, Federal scouts found the European corn borer present in 34 towns in Connecticut—all in the eastern and southeastern portion except Suffield which is in the northern central portion of the State. Quarantined areas are shown in Fig. 7.

Though the percentage of infested stalks was not large in any corn field in 1928, the intensity of the infestation is greatest in Stonington and will increase throughout the State. If not held in check by the destruction of corn stalks and stubble, it will soon cause serious losses. Over one-half of Rhode Island in 1928, the corn borer caused a commercial loss in the corn crop and the same will soon be true in Eastern Connecticut unless the pest can be held in check.

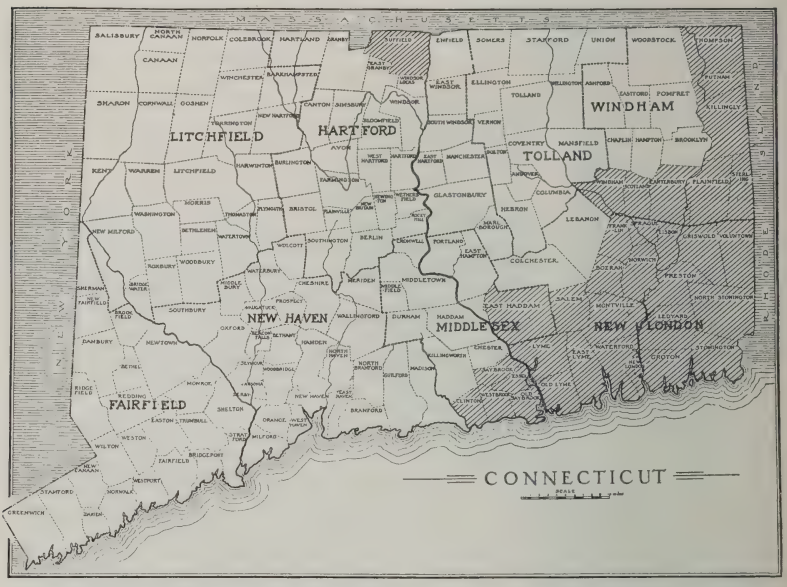

FIG. 7. Map of Connecticut showing areas now under State and Federal quarantine on account of the European corn borer.

DISCOVERY AND SPREAD IN THE UNITED STATES

The European corn borer was first discovered in the United States in Eastern Massachusetts, near Boston, in 1917, and this infestation has now spread into Maine, New Hampshire, Rhode Island and Connecticut. Two broods or generations occur each year in this area.

In 1919, there was discovered an infestation just west of Albany, N. Y., one south of Buffalo, N. Y., and a third at Girard, Pa., near Lake Erie.

In 1920, two infestations were found in Ontario, Can., one just across the Niagara River from Western New York, and the other farther westward along the shore of Lake Erie with its center near St. Thomas. These infestations in New York and westward have only one generation each year.

In 1921, the insect was found in Ohio along the south shore of Lake Erie. In 1923, small infestations were found in Connecticut and Brooklyn, N. Y.

By 1928, the one-generation area included nearly all of Ohio, the entire state of Michigan, a portion of Indiana, northern and western Pennsylvania, New York, a portion of Vermont, western Massachusetts, a few towns in New Jersey, Staten Island, the western end of Long Island, and the town of Suffield, Conn., which is an apparent spread of this infestation eastward through western Massachusetts. In Eastern Connecticut there are two generations annually.

METHODS OF CLEAN-UP AND CONTROL

For the past five years, the stalks, stubble and weeds have been burned in and around each separate infestation in Connecticut at the expense of the State and Federal governments and in many cases no borers were found the next season. With the large number of towns infested, appropriations are inadequate to continue this system, and the grower must control the pest in his cultural operations. As the borers pass the winter in corn stalks, stubble and weeds, the following methods of handling the infested crop will greatly reduce the injury next season:

1. Corn stalks should be cut just as early as possible after maturity and put in the silo or fed out to cattle. When fed out, uneaten portions of stalks should be destroyed. If allowed to stand, such stalks furnish a favorable shelter for borers.

2. If cut close to the surface of the ground, very few borers will be contained in the stubble. If cut 6-12 inches high, the stubble may furnish enough borers to ruin the crop the following year, and such stubble should be plowed under cleanly, or pulled and burned.

3. Corn stalks which are not cut and used for silage or fodder should be burned in the field or cleanly plowed under. The larger weeds in the fields and around its margins should also be burned.

4. By clean plowing in the fall, a large percentage of the second-brood borers are killed during the winter. Fall plowing is somewhat less effective against the single-brooded borers, but against both one-generation and two-generation borers, early spring plowing (during April) is beneficial, especially if all debris is covered deeply. There are now plows and attachments devised to facilitate the clean plowing under of standing corn stalks, and your county agent can advise you regarding them.

5. Small patches of sweet corn in back yard gardens can perhaps be pulled and burned to best advantage. If not cleaned up, such places will produce enough borers to infest the entire countryside.

QUARANTINE

After due notice and a public hearing at the Station February 25, the following quarantine order was issued, effective March 25, 1929. This is in accord with Federal quarantine No. 43, sixth revision, effective March 1, 1929.

STATE OF CONNECTICUT
AGRICULTURAL EXPERIMENT STATION

New Haven, Conn.

Quarantine Order No. 21

Concerning the European Corn Borer

The fact has been determined that the European corn borer, *Pyrausta nubilalis* Hubn., has spread to such an extent as to make it necessary to extend the area restricted by State Quarantine Order No. 13, effective June 1, 1927, and likewise to bring it into conformity with Federal Quarantine No. 43, sixth revision, effective March 1, 1929.

Now, therefore, I, Director of the Connecticut Agricultural Experiment Station, do hereby proclaim the following towns (including those affected by Quarantine Order No. 13) to be under quarantine and subject to the restrictions and regulations made a part of Federal Quarantine No. 43, as revised, and effective March 1, 1929:

Regulated Areas

Two-Generation area: Clinton, East Haddam, Essex, Old Saybrook, Saybrook, and Westbrook in Middlesex County; Bozrah, East Lyme, Franklin, Griswold, Groton, Ledyard, Lisbon, Lyme, Montville, New London, North Stonington, Norwich, Old Lyme, Preston, Salem, Sprague, Stonington, Voluntown and Waterford in New London County; Canterbury, Killingly, Plainfield, Putnam, Scotland, Sterling, Thompson and Windham, in Windham County.

One-Generation area: Suffield, in Hartford County.

Movement of Restricted Plants

Until further notice, unless accompanied by a certificate or permit issued by an authorized inspector of the State or Federal Plant Quarantine and Control Administration, the following plants and plant materials cannot be allowed movement from the restricted areas to points outside, or from the two-generation area into the one-generation area or from the one-generation area into the two-generation area: corn, broom corn, sorghum and sudan grass including all parts of leaves and stalks throughout the year; from the two-generation area all cut flowers and entire plants of chrysanthemum, aster, cosmos, zinnia, hollyhock, gladiolus and dahlia (except gladiolus and dahlia bulbs without stems) and for the period between June 1 and December 31, all celery, green beans in the pod, beets with tops, rhubarb, oat and rye straw as such or when used as packing.

No restrictions are placed on the movement of shelled corn in packages weighing two pounds or less; larger quantities must be certified.

This order shall take effect March 15, 1929.

W. L. Slate,
Director, Connecticut Agricultural Experiment Station

Approved:
John H. Trumbull, *Governor.*

For additional information, address,

W. E. Britton, State Entomologist, Agricultural Experiment Station, New Haven, Conn. In charge of State regulatory work.

H. N. Bartley, 1188 Main St., Bridgeport, Conn. In charge of Federal work in Connecticut.

Bulletin of Immediate Information No. 64

April 15, 1929

Connecticut Agricultural Experiment Station
New Haven, Connecticut

The Japanese Beetle Quarantine

W. E. Britton

The Japanese beetle, *Popillia japonica* Newman, a serious pest of native and cultivated trees and shrubs, is now present at several widely separated

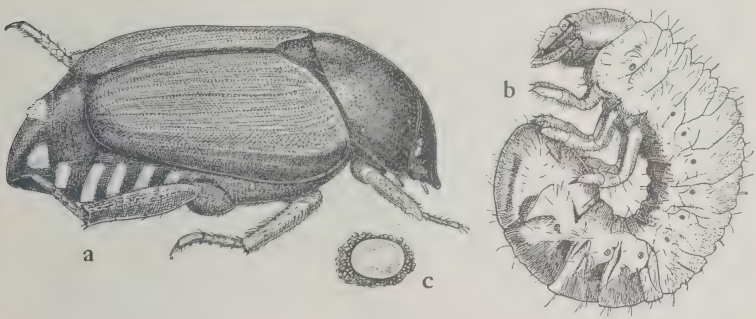

Fig. 8. The Japanese beetle. a, adult beetle; b, grub or larva; c, egg, all enlarged about five times.

points in Connecticut. The egg, grub and beetle are shown in Fig. 8. The eggs are white and are laid in the soil. The grubs are white and feed upon grass roots in the soil. The beetles are bright, shining green, with copper-colored wing-covers. There are two white patches on the tip of the abdomen beyond the wing covers, and five on each side of the abdomen, all composed of white hairs. The beetle is about half an inch in length and flies about actively in the warm sunshine. It feeds upon the tender foliage of fruit, shade and woodland trees, grape vines, roses and many shrubs and plants. It is present from late June until late September, but is most abundant about the middle of July.

DISCOVERY AND SPREAD IN THE UNITED STATES

Originally from Japan, this insect was discovered to be present at Riverton, N. J. in 1916. Since then it has spread in all directions and at present infests the state of New Jersey, the eastern third of Pennsylvania, Delaware, a small portion of Maryland, Alexandria, Virginia, District of Columbia, Long Island, and Westchester County, N. Y., and a portion of Connecticut as shown in Fig. 9.

OCCURRENCE AND SPREAD IN CONNECTICUT

The Japanese beetle was first found in Connecticut at Stamford by Federal scouts, late in the summer of 1926. Only eighteen adults were taken, mostly in two rear yards on the south side of Broad Street nearly opposite the end of Franklin Street. In July, 1927, beetles were found in Bridgeport at eight different centers, well distributed over the city. They were much the most abundant, however, just south of Washington Avenue, where about 186 were taken. One was found in Darien and one in New Canaan. In 1928, Federal scouts found small infestations in New Haven, Hartford and New London, and a larger one at Springfield, Mass.

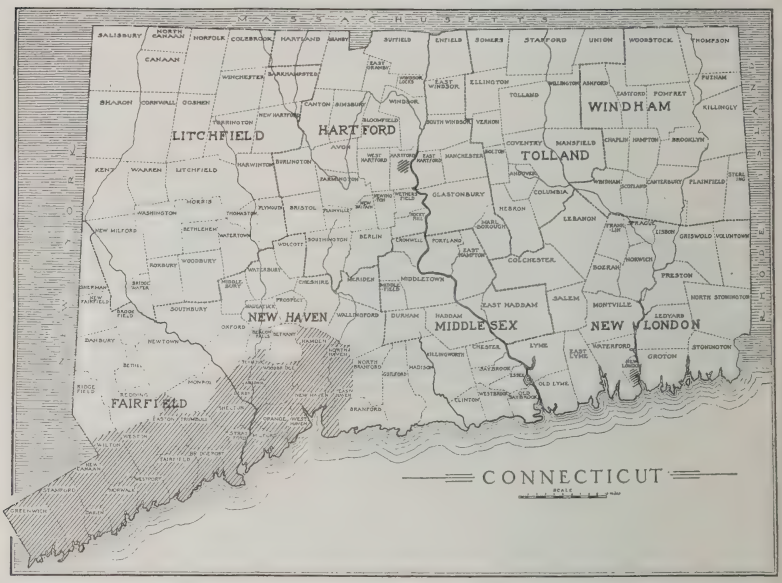

FIG. 9. Map of Connecticut. Shaded areas indicate territory quarantined on account of Japanese beetle.

METHODS OF CONTROL

The Japanese beetle is a difficult pest to control, though foliage and fruit may be protected by spraying heavily with coated lead arsenate. Small trees and shrubs may be protected by covering them with netting. The beetles may be attracted by certain chemical odors and then killed by a contact spray which has been devised containing oleoresin or pyrethrum and a sodium oleate soap. The grubs in lawns may be killed by applying an emulsion of carbon disulphide, or by treating the surface layer with lead arsenate, at the rate of three pounds per 100 square feet.

QUARANTINES

On account of the distribution of the beetle, Federal quarantine No. 48 (Fifth revision) extends the Bridgeport area to include New Haven and surrounding towns. The State quarantine coincides with the Federal quarantine (Fig. 9), but places additional restrictions on certain areas in Hartford and New London as shown in Figs. 10 and 11. The Quarantine Order follows:

STATE OF CONNECTICUT
AGRICULTURAL EXPERIMENT STATION
NEW HAVEN, CONN.

Quarantine Order No. 20

CONCERNING THE JAPANESE BEETLE

The fact has been determined that the Japanese beetle, *Popillia japonica* Newman, has been found in the cities of New Haven, New London and Hartford, and to prevent the further spread of this pest it is necessary

FIG. 10. Map of Section of Hartford. The dotted line surrounds area under State quarantine on account of Japanese beetle.

to extend the quarantine restrictions over certain additional areas, regarding which a public hearing was held in New Haven, February 25, 1929. Federal quarantine No. 48 has also been revised, effective February 15, 1929, to include eleven additional towns in New Haven County.

Now, therefore, I, William L. Slate, Director of the Connecticut Agricultural Experiment Station, under authority conferred by Chapter 31, Public Acts of 1927, do hereby proclaim the regulated area fixed by State Quarantine Order No. 16, and by the rules and regulations supplemental to Federal Quarantine No. 48 (Fifth Revision), effective on and after April 1, 1927, as amended effective on and after November 1, 1927, namely, the towns of Bridgeport, Darien, Easton, Fairfield, Greenwich, New Canaan, Norwalk, Shelton, Stamford, Stratford, Trumbull, Weston, Westport, and Wilton, in *Fairfield County*, to be extended to include the eleven towns of Ansonia, Derby, East Haven, Hamden, Milford, New Haven, North Haven, Orange, Seymour, West Haven and Woodbridge, in *New Haven County*.

Also, that that portion of the City of Hartford bounded by Farmington Avenue, Spring Street, Walnut Street, Sargent Street, and Sigourney Street, is hereby quarantined.

Also, that that portion of the City of New London bounded by Huntington Street, Bristol Street, Williams Street, Manwaring Street, Hempstead Street, Franklin Street, Cottage Street, and Broad Street, is hereby quarantined.

The rules and regulations supplemental to Federal Quarantine No. 48 (Sixth Revision), effective on and after February 15, 1929, or any subsequent amendments thereto, restricting the interstate movement of quarantined articles from the regulated areas, are hereby declared to be in full force and effect with respect to the intrastate movement of quarantined

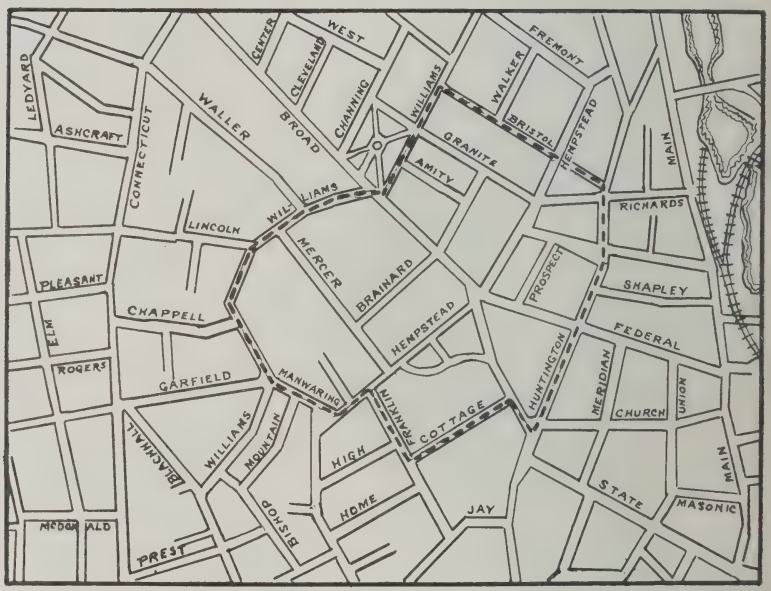

FIG. 11. Map of Section of New London. The dotted line surrounds area under State quarantine on account of Japanese beetle.

articles from the herein designated regulated areas of Connecticut to unregulated portions thereof.

This order shall be effective on and after April 1, 1929.

W. L. SLATE,
Director, Connecticut Agricultural Experiment Station

Approved:

JOHN H. TRUMBELL, *Governor.*

For further information regarding the Japanese beetle, apply to:

W. E. BRITTON, State Entomologist, Agricultural Experiment Station, New Haven, Conn.

or J. P. JOHNSON, Hurley Building, Shelton, Conn.

For inspections and certificates, shippers should apply to:

J. P. JOHNSON, Hurley Building, Shelton, Conn. (Telephone, Derby 2974).

Bulletin of Immediate
Information No. 65

April 15, 1929

Connecticut Agricultural Experiment Station
New Haven, Connecticut

The Asiatic Beetle Quarantine

W. E. Britton

The Asiatic beetle, *Anomala orientali* Waterh., is a serious pest of lawns, as the grubs devour the grass roots. This beetle is probably a native of

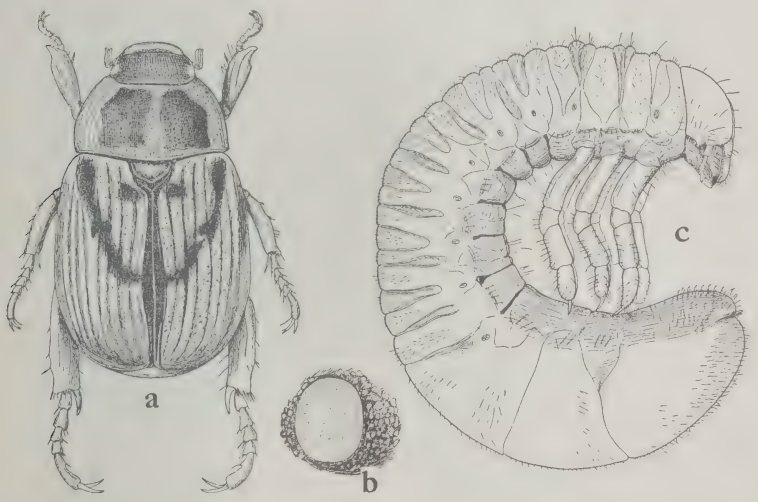

Fig. 12. The Asiatic beetle. a, adult beetle; b, egg; c, grub or larva. All enlarged about five times.

eastern Asia, and was first taken in the United States at New Haven, Conn., in July, 1920. It now occurs at New Haven and West Haven, Conn., on Long Island, and at several points in Westchester County, N. Y., and at several points in New Jersey. This beetle has one generation each year and is shown in Fig. 12. The beetles are not very active feeders or fliers, consequently the chief means of spread is by transporting the grubs in soil or turf, in soil about the roots of plants, garden litter, and the beetles in cut flowers. The control of this insect in lawns is treated in Bulletin of Immediate Information No. 62, of this Station, March 1, 1929.

QUARANTINES

Federal quarantine, No. 66, places restrictions on the movement of plants and certain materials from New Haven and West Haven. The

State quarantine conforms with the Federal regulations, but places additional restrictions on certain areas in these towns as shown in Figs. 13, 14 and 15. The Quarantine Order follows:

STATE OF CONNECTICUT
AGRICULTURAL EXPERIMENT STATION
New Haven, Conn.
Quarantine Order No. 22
Concerning The Asiatic Beetle

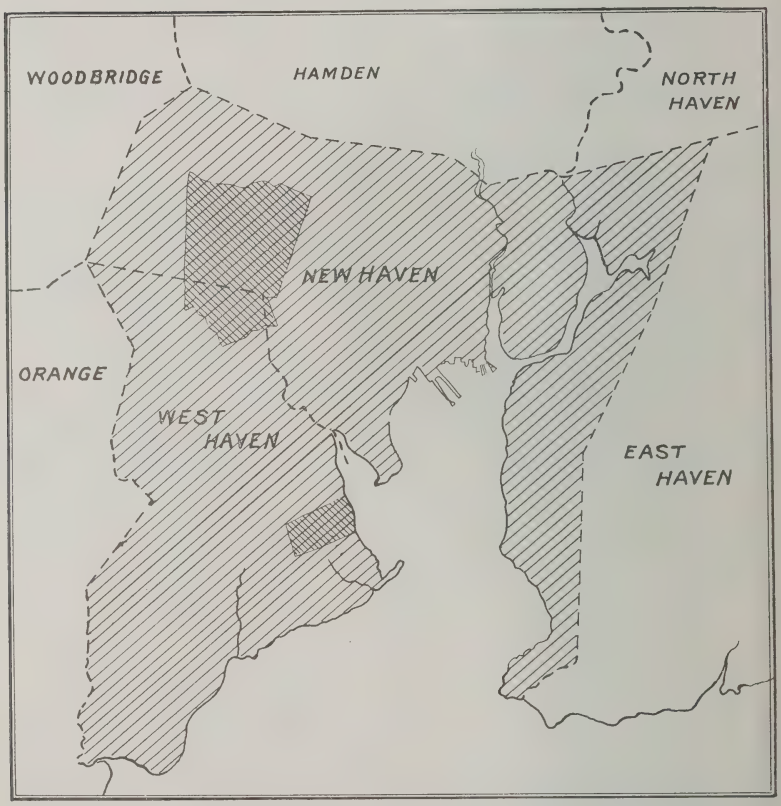

Fig. 13. Map of New Haven and West Haven now under quarantine on account of Asiatic beetle. Darker shaded sections show infested areas, upon which additional restrictions have been placed by State quarantine.

The fact has been determined that the Asiatic beetle, *Anomala orientalis* Waterhouse, now occurs in the towns of New Haven and West Haven and it seems advisable to revise the regulations and the restricted areas. A public hearing regarding the matter was held in New Haven, February 25, 1929.

Now, therefore, I, William L. Slate, Director of the Connecticut Agricultural Experiment Station, under authority conferred by Chapter 31,

Public Acts of 1927, do hereby proclaim the towns of New Haven and West Haven subject to the restrictive regulations of this quarantine.

Also, the movement of all quarantined articles designated in the regulations supplemental hereto are further restricted from any point within the hereinafter designated control areas to other portions of the towns of New Haven and West Haven or to points outside thereof.

The following control areas are hereby designated:

Westville Area:—Bounded by Whalley Avenue, Blake Street, Ruby Street, Moreland Road, Ellsworth Avenue, Derby Avenue, Boulevard, Oak Street, Forest Road, Florence Avenue from a point about 400 feet

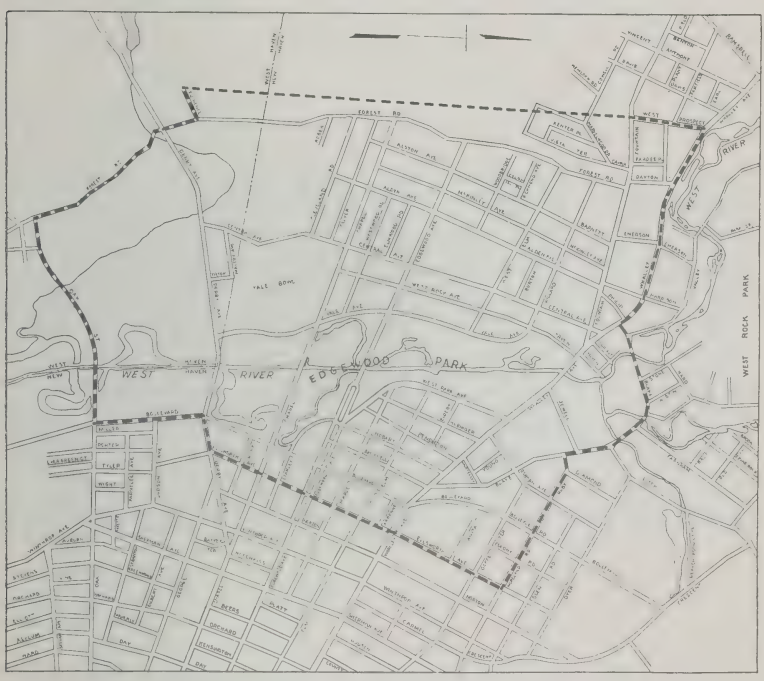

FIG. 14. Map of the Westville section of New Haven. The area enclosed by dotted line is infested and under special State quarantine restrictions.

west of Forest Road, in a straight line northward to West Prospect Street to Whalley Avenue, and all territory within these boundaries, being partly in New Haven and partly in West Haven.

West Haven Area:—Bounded by Center Street, New Haven Harbor, Brown Street, and Campbell Avenue.

Until further notice the movement of certain articles and materials as designated below will not be permitted except where inspection or treatment is practicable and permits are issued by duly authorized agents of the State or the United States Department of Agriculture.

The articles and materials restricted during the entire year are as follows:

1. Sand, soil, earth, peat, compost and manure;
2. Nursery, ornamental and greenhouse stock, and all other plants;
3. Turf or sod trimmings, lawn or shrub clippings, ground litter, and weeds.

The articles and materials restricted only between June 15 and October 15, inclusive, are as follows:

1. Cut flowers
2. Hay and straw (freshly cut)

The rules and regulations supplemental to Federal Quarantine No. 66, effective on and after March 15, 1922, or any subsequent amendments thereto, restricting the interstate movement of quarantined articles from the regulated areas, are hereby declared to be in full force and effect with

FIG. 15. Map of section of West Haven. The area enclosed by dotted line is infested and under special State quarantine restrictions.

respect to the intrastate movement of quarantined articles from the herein designated areas of Connecticut to portions thereof.

This order shall be effective on and after April 1, 1929.

W. L. SLATE
Director, Connecticut Agricultural Experiment Station.

Approved:

JOHN H. TRUMBULL, *Governor.*

For additional information and for shipment permits wholly within the towns of New Haven and West Haven, apply to

W. E. BRITTON, State Entomologist, Agricultural Experiment Station, New Haven, Conn.

For shipment permits to points outside of New Haven and West Haven, apply to

J. P. JOHNSON, Hurley Building, Shelton, Conn. (Telephone Derby 2974).

Bulletin of Immediate
Information No. 66

April 15, 1929

Connecticut Agricultural Experiment Station
New Haven, Connecticut

The Satin Moth Quarantine

W. E. Britton

The satin moth, *Stilpnotia salicis* Linn, was first discovered in the United States in June, 1920, a few miles north of Boston, Mass., whence

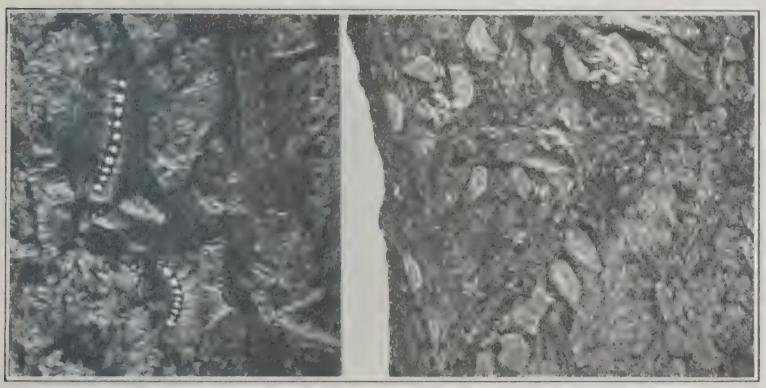

Fig. 16. The satin moth. At left, caterpillars, and at right, winter cases (After Burgess and Crossman, Dept. Bull. 1469, U. S. Dept. of Agriculture).

this European pest of willow and poplar has spread until it now occupies the eastern three-fourths of Massachusetts, the whole of Rhode Island, the eastern half of Connecticut, southern New Hampshire, southwestern Maine, and a few towns in southeastern Vermont.

In 1922, this insect was found at Bellingham, Washington, on the Pacific coast, and it now occupies nearly all of the western half of that State.

OCCURRENCE IN CONNECTICUT

In 1926, Federal scouts found the satin moth in two towns in Connecticut, Thompson and Stonington, which were placed under Federal quarantine. In 1928, State gipsy moth scouts found the insect in various towns scattered throughout the eastern portion of the State and in Suffield and Hartford, west of the Connecticut River.

INJURY AND REMEDY

The caterpillars feed upon the foliage of willow and poplar trees, often defoliating them. The remedy is to spray with lead arsenate in May, as soon as the trees are in full foliage.

CHARACTERISTICS OF THE INSECT

Both male and female moths are satiny white, without markings, and with a wing-expanse of nearly two inches. The eggs are laid in July on the bark in oval silvery-white patches about half an inch wide and three-fourths of an inch long, each containing an average of about 300 eggs.

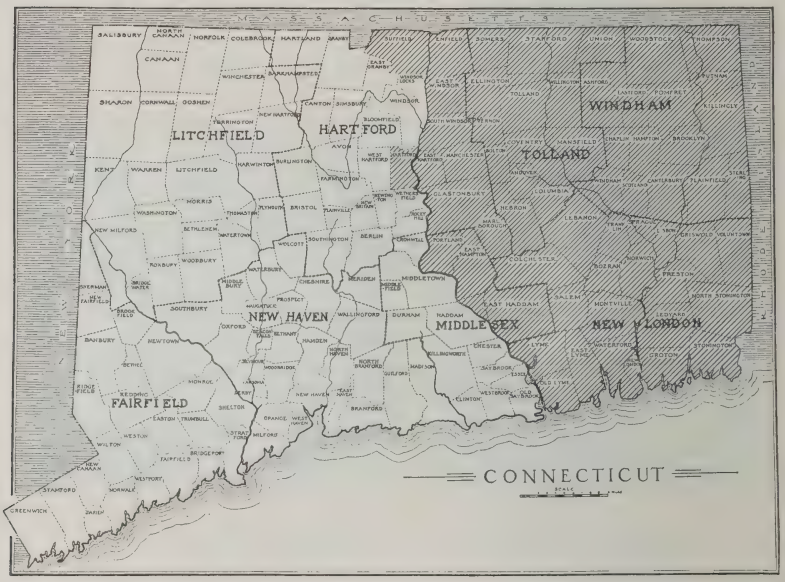

FIG. 17. Map of Connecticut. Shaded portion is now under State and Federal quarantine on account of the satin moth.

The caterpillars pass the winter when partially grown, in silk cases in cracks of the bark. In spring, they emerge and feed upon the unfolding leaves, becoming fully grown in June. They are then about one and one-half inches in length, reddish-brown in color, with two narrow broken white lines lengthwise the back with a central row of white spots somewhat dumbbell-shaped, as shown in Fig. 16. They make their cocoons in folded leaves, crevices of the bark, in rubbish and on fences and buildings. The moths come forth about ten days later.

QUARANTINE

Since November 15, 1926, Federal Quarantine No. 53, has covered the towns of Thompson and Stonington, but no State quarantine has hereto-

fore been established on account of the satin moth. The present quarantined area is shown in Fig 17, and the quarantine amounts to an absolute embargo. The movement of willow and poplar trees is not allowed as the difficulty of detecting the winter cases is so great that inspection is not attempted. The quarantine order follows:

STATE OF CONNECTICUT

AGRICULTURAL EXPERIMENT STATION

New Haven, Conn.

Quarantine Order No. 19

Concerning The Satin Moth

The fact has been determined that the Satin moth, *Stilpnotia salicis* Linn., a pest of poplar and willow trees is now present in various towns in Connecticut, and that Federal Quarantine No. 53 has been revised, effective, January 1, 1929, to include all towns in Connecticut east of the Connecticut River, and the towns of Hartford and Suffield, west of the Connecticut River. After due notice a public hearing was held at the Station in New Haven, February 25, 1929.

Now, therefore, I, Director of the Connecticut Agricultural Experiment Station under authority conferred by Chapter 31, Public Acts of 1927, do hereby proclaim that a State quarantine is placed on all towns east of the Connecticut River, and the towns of Hartford and Suffield west of the Connecticut River,and that it shall be unlawful to move any poplar or willow trees or parts thereof capable of propagation, from the restricted area designated above to any other portion of the State.

This order shall take effect March 15, 1929.

W. L. Slate,
Director, Connecticut Agricultural Experiment Station.

Approved:
John H. Trumbull, *Governor.*

Bulletin of Immediate Information No. 67 July 20, 1929

Connecticut Agricultural Experiment Station
New Haven, Connecticut

Control of Ant Invasions*

By W. E. Britton, *Entomologist.*

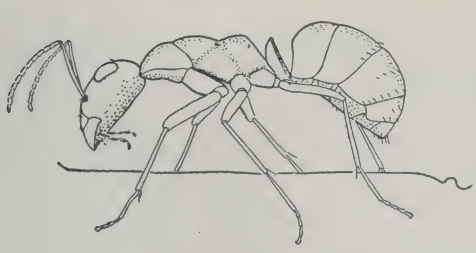

Fig. 18. Side view of a worker ant, greatly enlarged.

During every summer season a large number of inquiries are received at the Station regarding ants and how to exterminate them. Each year ant colonies are reported from some localities as making ant hills on the lawn, injuring plants, entering houses, or perhaps tunneling in trees or timbers.

Ants belong to the Order Hymenoptera and are social insects living in colonies containing queens, males and workers. In general ants are considered as beneficial rather than injurious as they work over the soil much like angle worms, and they devour particles of animal and vegetable matter, thus destroying many dead, and some living, insects. Certain species are distinctly injurious and are mentioned in the following pages.

The object of this bulletin is to give brief information about the habits of ants and to indicate how ants may best be controlled.

NESTING PLACES OF ANTS

Most of our common species of ants nest in the ground where they form ant hills, or reside under stones and pieces of wood. Certain species have large colonies and bring to the surface of the ground particles of sand and gravel, bits of wood and other materials, forming large ant hills. These ants cut off the roots of plants which happen to be where they make their galleries. Certain small species like the Argentine ant now present in our Southern States and the little red house ant or Pharaoh's ant, occasionally found in Connecticut, may nest in houses. The large black ant or carpenter

*Revised edition of Bulletin of Immediate Information No. 17, July, 1922.

ant makes its nest inside the trunks of trees, old logs, stumps, fence posts, and in the structural timbers of buildings and bridges, often honeycombing and weakening the wood. The so-called white ants, or termites, have nesting habits similar to those of the large black ants, and often do considerable damage to structural timbers.

ANTS ON PEONIES

Ants nearly always crawl about on peonies, though I have never known them to cause any injury. Peony buds are said to have nectar glands which attract ants, and this seems to be the most reasonable explanation of their presence on the plants, for as a rule peonies are not infested with aphids. Control measures are therefore not necessary, though in some

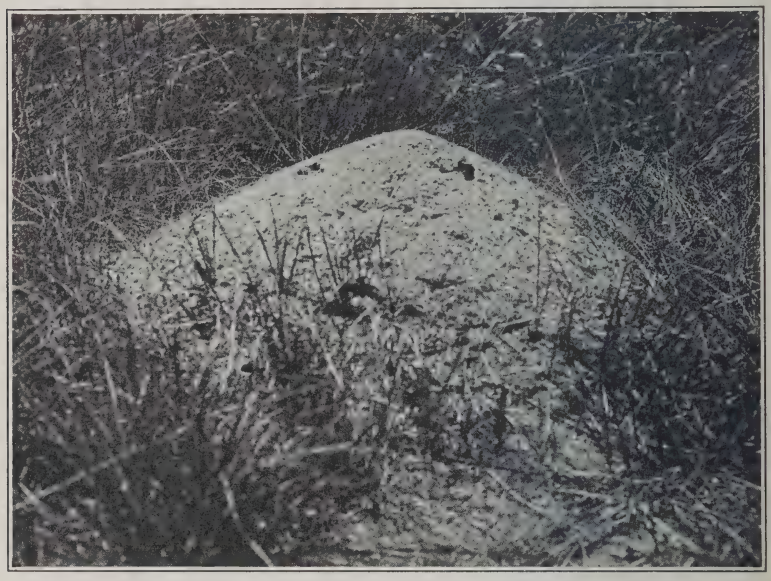

Fig. 19. Characteristic ant hill of *Formica exsectoides* Forel.

cases it may be possible to keep them away from the plants by mulching the latter with air-slaked lime, fine sifted coal ashes, or by wrapping the stems with sticky fly paper.

ANTS AND PINE TREES

In young white pine plantations, it has been noticed that the trees always die near the large ant hills,[1] as shown in Fig. 19, and recent studies by Mr. H. B. Pierson[2] show that the ants kill the trees which are in danger

[1] *Formica exsectoides* Forel.
[2] Mound Building Ants in Forest Plantations, Journal of Forestry, Vol. 20, page 325, April, 1922.

of shading their nests. This is true not only of the pines planted, but also of native seedlings and sprouts of hardwood trees which spring up near the nests. Consequently in young forest plantations, the ants in such nests should be killed by fumigating with carbon disulphide, or "cyanogas".

ANTS AND APHIDS ON TREES AND PLANTS

Except certain species of ants which nest in trees, those crawling about on the leaves and up and down the stems and branches are in search of food. An important article of ant food is the substance called honey dew exuded by certain insects, particularly aphids, psyllids, aleyrodids, tree hoppers and scale insects. Aphids are called the "milch cows" of the ants and the latter are known to take care of certain species of aphids to the extent of carrying them in fall to the roots and in spring back to the foliage. The ants are present, therefore, not to injure the plants but to obtain foods from the aphids or scale insects which may be sucking sap from the plants. On account of the distinctly injurious nature of these insects which are fostered by the ants, the latter are considered enemies of mankind.

In such cases, probably the best treatment is to spray the trees or plants thoroughly with a contact insecticide like nicotine solution and soap to kill the insects.

ANTS IN GARDENS AND LAWNS

Ants often make small ant hills on lawns, especially in sandy soil, by bringing sand and fine gravel from their burrows to the surface of the ground. These are unsightly and interfere with the work of cutting the grass, especially with the edge on the knives of the lawn mower. They are also a nuisance by bringing particles of sand to the surface in cracks of walks and drives.

Where ants emerge through small cracks, carbon disulphide may be injected through the nose of an oil can and the hole stopped with soil. For nests in lawns, a hole should be made fifteen to eighteen inches deep with a crowbar, iron rod or stake, and the carbon disulphide poured into the hole. A half teacupful will be enough for the larger nests and the smaller ones may be given two large spoonfuls. As some of the ants will be out of the nest at the time of treatment, it may be necessary to repeat as soon as the ant colony resumes activity. The fumes of this ill-smelling liquid are volatile and will permeate the galleries and kill the ants in them. As carbon disulphide is inflammable, it should not be used near any form of fire, particularly in or around buildings or wooden structures. It comes in pound bottles or cans and may be purchased from druggists and dealers in insecticides. "Cyanogas" may be used for the same purpose, but it usually kills the grass around the hole, and hence is not so desirable for use in lawns.

ANTS IN HOUSEHOLDS

Most of the ant invasions in dwelling houses come from the colonies established in the garden or soil outside, and the destruction of these colonies will bring relief. The ants are after food and usually visit the

kitchen and the pantry, where they gather crumbs of bread, cake, meat and particles of sugar to carry away to their young. Usually they enter the house or cellar at a certain place, and all of the individuals travel along this path or runway. Many methods of getting rid of ants in houses have been recommended. Most of them fall into the classes of repellents, traps and poisons.

Repellents: Borax, naphthalene, paradichlorobenzene, camphor, oil of cedar, tobacco, sulphur, powdered cloves, mustard and insect powder. It is said that ants can be poisoned by feeding them on borax and sugar. Extracts of insect powder are also used to kill ants in some of the proprietary liquid insecticides on the market, such as "Flit", "Verm-o-Spray", etc. However, most of the substances mentioned above are repellents, and may be scattered along the runways and on the shelves, floors, and points of entrance will often drive away the ants within a few hours. A free use of naphthalene flakes in such places will usually drive away most species.

Traps: Ants may be trapped by plates greased with lard: the ants will congregate there in great numbers, and may be killed with hot water. Ants are also attracted by sugar and bits of ham. A favorite trap consists of a coarse sponge saturated with sugar and water; after permitting the ants to crawl into it, they may be killed by immersing the sponge in hot water.

Poisoned Bait: Sometimes there are cases where the ants nest in houses, as do the Argentine ant[1] which is now present in the Gulf States, and the little red house ant or Pharoah's ant[2] which occurs in Connecticut when the foregoing described methods of control are not effective, and it may be necessary to use a poisoned bait to exterminate the colonies. The object of the bait is not only to kill the ants which collect and carry the sirup back to the nests, but also the young and the queens in the nest which feed upon it.

Tarter emetic mixed with about twice its bulk of sugar and enough water to make a thick syrup, placed on a piece of cardboard, is an excellent poison for certain kinds of ants.

The following formula was recommended by the U. S. Bureau of Entomology in Farmers' Bulletin No. 740, and has proved satisfactory against Pharaoh's ant[3] in a dwelling house in Hartford:

Poisoned Bait for Ants

Sugar	1 pound
Arsenate of Soda	125 grains
Water	1 quart
Honey	1 tablespoonful

Dissolve the sugar in the water, and add the arsenate of soda: boil until both are well dissolved, then add the honey which is said to attract the

[1] *Iridomyrmex humilis* Mayr.
[2] *Monomorium pharaonis* Linn.
[3] Report of the Connecticut Agricultural Experiment Station for 1917, page 314.

ants. When cool, use with bits of sponge in small shallow dishes, or on pieces of cardboard, and place two or three in each room.

The baits have been used successfully against various kinds of ants both in the house and out of doors. The poison should be put in protected places where young children, domestic animals and birds cannot reach it but where the ants will have access to it.

ANTS TUNNELLING IN WOOD

Black Ants

The large black ants commonly known as carpenter ants[1] nest in galleries which they eat in old logs, stumps, fence posts, rails, props and trees, and they occasionally eat away the timbers of houses to make their nests. They also gather sweets from kitchen and pantry. They both enter the house from outside, and in some cases nest in the structural timbers which soon may be considerably weakened.

Perhaps the best way to kill this species is to bore holes from the outside into the galleries and by means of a funnel, and rubber tube if necessary, pour in enough carbon disulphide to kill all ants inside the burrows. The hole should then be plugged to prevent the fumes from escaping. These large ants can also be trapped in sweetened sponges and can be fed with the poisoned bait if desired.

White Ants

There is in Connecticut another wood-eating species called the white ant or termite,[2] which is white in its immature stages but brown in the adult stage. These white ants are only remotely related to the true ants and belong to a different order (Isoptera). They are social and nest in wood and swarm at a certain time in early summer. They do not visit the pantry and kitchen in search of food like the true ants, and so far as I know are not attracted by sweets. They often breed in stumps, fence posts, board edges of tar walks, old trees and sometimes in the timbers of houses and bridges. Other species in the tropics do a tremendous amount of damage by destroying buildings and there are records of large structures collapsing because weakened by the feeding of these termites. There are many records in the United States and some in Connecticut of buildings having been injured by termites. In 1909, an old house in South Norwalk,[3] and in 1915 a house in Ridgefield,[4] had the timbers and finish boards eaten by them. Trees and herbaceous plants in the field and greenhouse are occasionally attacked and injured. In 1914,[5] the author received geranium plants from New Rochelle, N. Y., where more than two hundred plants had been ruined by these insects which tunneled out the inside of the stems. In 1916, shot gun cartridges were received at the Station which had been eaten by white ants in a store in Wichita, Kans. In 1921,[6] a colony of these

[1] *Camponotus herculeanus pennsylvanicus* De Geer.
[2] *Reculitermes flavipes* Kollar.
[3] Report of the Connecticut Agricultural Experiment Station for 1909, page 373.
[4] *Ibid.*, 1915, page 187.
[5] *Ibid.*, 1914, page 196.
[6] *Ibid.*, 1921, page 199.

insects chewed off the insulation from the telephone wires in the basement of a large office building in New Haven.

There are also records of injury to food stuffs and other stored material, to fruit, nut, shade and forest trees, to field crops, garden vegetables, vineyards, nursery stock, shrubs, flowers and greenhouse plants. Where white ants are tunneling in structural timbers, a free use of carbon disulphide as advised for the carpenter ant, is the best remedy. Probably creosote poured into the galleries afterward may have a tendency to prevent reinfestation. Some of the timbers near the ground may need replacing with cement concrete which is proof against injury.

WINGED ANTS AND WINGLESS ANTS

In most of our species of true ants the workers are wingless, and the males and queens have wings.

The queen breaks off her wings (or the workers do it for her) soon after mating and after the swarming flight is over. It is the workers without wings which invade our houses, run over our trees and plants, make ant hills in the lawn, and tunnel in wood. Sometimes winged ants are seen at swarming time flying in the air or resting or crawling upon objects, but by far the most striking cases occur with our common white ant.[1] Often late in May, brown winged males and females may be seen emerging in large numbers from a fence post, old stump or log, side of an old building or board along the edge of a tar walk. They fly through the air in swarms, mate, and migrate to new localities in this manner. A swarm will alight, the wings are broken off, and a new colony is started. We have all seen these wings upon the ground and supposed that birds or other animals had devoured the ants in a swarm, leaving only the wings, but such is not the case. The wings are broken off at a point near the body, and it is done by the ants themselves.

SUMMARY OF CONTROL MEASURES

Kill ants in their nests by fumigating with carbon disulphide, or with "cyanogas".

Drive them out of houses by scattering naphthalene flakes or some other repellent on shelves and floors, particularly along the runways; trap them with lard, ham, sugar, or in sponges moistened with sweetened water. If these measures are not successful, use one of the poisoned baits described on page xxviii.

On trees and plants destroy the aphids or other insects which attract ants.

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[1] *Reculitermes flavipes* Kollar.

318 May, 1930

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REPORT OF THE DIRECTOR

For The Year Ending October 31, 1929

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Connecticut
Agricultural Experiment Station
New Haven

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

Officers and Staff, As of October 31, 1929

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REPORT OF THE DIRECTOR

For the Year Ending October 31, 1929

To the Board of Control of the Connecticut Agricultural Experiment Station:

In discussing the events of the past year there comes to mind at once the death of Dr. Thomas B. Osborne whose outstanding work in biochemistry and nutrition brought fame and honor, not only to himself but to the Station where he spent his entire professional life. A memorial is now being prepared, to be published as a Station bulletin, in which we have tried to record our high regard for our fellow worker and friend. It will include certain unpublished papers of Dr. Osborne, a complete bibliography and a number of biographical and personal papers.

Mr. Charles R. Treat of Orange, for many years a member of the Board of Control and in recent years its vice-president, died in February. To the Station this was a great loss. Mr. Treat's interest in the work of the Station was always active, intelligent and helpful; his judgment was sound and his time freely given.

Each year brings new problems to the farmers of the state and many of these are passed on to the Station. The spread of the European Corn Borer, the Japanese Beetle, the Oriental Peach Moth and other insect pests has placed unusually heavy burdens upon us. The Peach Moth has become a major pest in many orchards and at the request of the growers we have undertaken an attack along the line that is now most promising, namely, the rearing and distribution of parasites. In September a fund was subscribed by the growers and a special allotment of $5,000 made by the State Board of Finance and Control. Work was begun immediately, involving the building and purchase of a large amount of equipment and the employment of two assistants. It is hoped that sufficient numbers of two parasites to bring about substantial control can be reared for release in peach orchards next June.

Other new enterprises are the inauguration of the plan to eradicate the black currant, an alternate host of the White Pine Blister Rust; the establishment of a field station at Windsor for the growing of forest planting stock, vegetable breeding and soil fertility studies. Mention should also be made of the enactment of a "pure seed law" by the General Assembly of 1929, under which the Station has accepted the task of examining the samples collected by the Commissioner of Agriculture.

Thus it will be seen that our duties are constantly increasing. The last addition to our building space was in 1912, when the main

laboratory was enlarged. To-day with a staff doubled in size we are very seriously crowded, with the result that it is increasingly difficult to carry on our work. New problems require new equipment and facilities which we are at present unable to house. At the last session of the General Assembly, an item of $45,000 for a new laboratory was included in our estimates, but this was eliminated from the budget. I present this as our greatest need and recommend that it be included in the estimates to be presented next fall.

CONTROL AND INSPECTION WORK

Inspection of Fertilizers, Feeds, Foods, Drugs, etc.

In accordance with the statutes relating thereto, the Analytical Chemistry Laboratory has analyzed 900 samples of *Fertilizers and Fertilizer Materials*. The report on these was published and distributed before the middle of December.

Similar control work on *Feeding Stuffs* has involved chemical analysis of more than 800 commercial and other fodder materials, many of which have had microscopic examination.

A report, Bulletin 307, upon food products and drugs summarizing inspection and analyses of 1320 samples, largely submitted by the Dairy and Food Commissioner, was issued in May of this year, covering the work done in the previous year. An equal volume of analytical work has been required in this branch of the service during the current year.

Statutes requiring the certification of *Glassware* used in the Babcock test for fat in milk and cream, and of thermometers to be used in dairies for checking pasteurization temperatures, have involved the examination of 2746 pieces.

No systematic inspection of *Insecticides* and *Fungicides* has been made but a considerable number of spray materials submitted by purchasers and others interested have been examined. A useful compilation of analyses (160 pages), of insecticides, fungicides, bactericides, rodenticides and weed killers was prepared and published in January of this year as Bulletin 300.

The department has also done a very considerable amount of analytical work in collaboration with the Tobacco Substation at Windsor and the Experiment Station at Storrs. Analyses of special foods have been made from time to time in coöperation with the American Medical Association's Council on Pharmacy and Chemistry. A review of the literature on color reactions for vitamins has been made and submitted to the Association of Official Agricultural Chemists and will be published in the journal of that

association. The laboratory has also continued to take part, with other control laboratories and industrial and trade laboratories in the United States, in programs of check analyses on cottonseed meal and on various fertilizer mixtures. And finally, the department is always interested in the examination of new food products and in special and miscellaneous food to the extent that time and facilities permit.

Control of Insect Pests

There has been no particular spread of the *Gipsy Moth* in Connecticut during the season. As in 1928, there was no noticeable defoliation of trees in Connecticut, but larger areas were stripped in Massachusetts, Maine and New Hampshire than ever before. We believe that this relative freedom from injury is due in large measure to the careful and thorough work in scouting and spraying carried on year after year in coöperation with the Federal forces.

The *Satin Moth* has continued to spread westward, and a State quarantine conforming with the Federal quarantine was placed on the eastern half of the State, effective March 15, 1929. The Federal quarantine was later revised, effective November 1, 1929.

The *European Corn Borer* has made an extensive spread, especially from the two-generation area in the eastern portion of the State. The entire State was scouted by Federal men and the pest found in 39 new towns. In revising quarantines, it has seemed best to include 30 of these infested towns together with seven towns not yet found infested but surrounded or nearly surrounded by infested towns, leaving nine towns in which clean-up work will be done.

The last General Assembly enacted a compulsory clean-up law, as a means of corn borer control, the compulsion depending upon orders and regulations issued by the Director of the Station for the quarantined area only. Federal agents patrolled the main highways along the margin of the quarantined area from July 15 to October 15.

There has been no important spread during the season of the *Japanese Beetle*. Federal agents scouted more than 60 of the cities and larger towns along the principal lines of traffic and shipping, and the only new infestation discovered was at Willimantic, where 21 beetles were found. Soil treatment was carried on at Hartford and New London in the infestation centers discovered in 1928, and where grubs were found. Notwithstanding this treatment, more beetles were caught in traps in both cities in 1929 than were found in 1928. Road patrol was maintained between June 15 and October 1 on the main highways leading out of the larger quarantined areas.

The only infestation of the *Asiatic Beetle* discovered outside of the quarantined towns of New Haven and West Haven was in a small private yard in Bridgeport. On an inspection tour for lawn injury, approximately 52 towns were visited, mostly in the central and western portions of the State outside the Japanese beetle quarantined area, but no signs of infestation were found. The insect has been found in New Haven outside of the former infested area.

There has been an increase in the number of nurseries, all of which have been inspected since July 1 by the Station entomologists. We have also inspected the fruit and rose stocks imported from Europe for propagation in Connecticut nurseries.

In the *Mosquito Elimination* work very substantial progress has been made. New ditching in Old Lyme started in 1928 was continued in the spring of 1929, until the appropriation of $5,000 was exhausted. Another $5,000 was appropriated and work is now going on. Ditches are now being cut in Hamden and all of the salt marsh area in that town will soon be completed. Many ditches were recut in the East River section of Madison, and all ditches have been maintained except in certain portions of Madison and Guilford.

Distribution of Forest Planting Stock

During the calendar year 1929, the Station distributed 1,458,000 trees for forest planting, shelter belts and wind breaks; at least 99 per cent was for forest planting purposes. Of the entire amount, 463,000 trees were sent to farmers under the Clarke-McNary Act. The rest went to water companies, manufacturing plants, estate owners and others. This is an increase of 10 per cent more than the number distributed in 1928, showing an ever increasing interest in reforestation.

White Pine Blister Rust

During the season of 1929, 134,407 wild Ribes and 10,922 cultivated Ribes were destroyed on 34,597 acres, in 20 towns. Approximately 18 per cent of the acreage covered was re-eradication work.

Nursery Sanitation Zones have now been established around 11 nurseries, including one area established this year. The ten previously established zones were rechecked. Five thousand nine hundred and sixty acres were inspected on this project this year and 1,182 wild Ribes and 1,814 cultivated Ribes removed.

The European Black Currant law, effective July 1, 1929, gives the Director the authority to conduct a state-wide campaign on the

elimination of this plant, which is an alternate host of the Blister Rust. The presence of this species of Ribes constitutes the most serious menace to the white pine.

SUMMARY OF WHITE PINE BLISTER RUST CONTROL, 1928-1929

Year	Initial erad. ac.	Re-erad. acres	Total ac. erad.	Wild Ribes destroyed	Cult. Ribes destroyed
1925	6,688	40	6,728	258,515	684
1926	21,687	570	22,256	182,826	330
1927	12,068	8,836	20,904	159,121	2,235
1928	68,539	1,122	69,661	123,383	1,151
1929	28,394	6,203	34,597	134,407	10,922

Seed Testing

For more than 50 years seed testing for farmers has been one of the Station's activities, it having pioneered in this work. The General Assembly of 1929 passed a statute requiring that all seeds, except of vegetables and flowers, be labeled as to germination and purity. The Commissioner of Agriculture is charged with the administration of the act, and the Station is making the examinations. This will increase the duties of the Botany Department and some provision should be made for financing the work.

Spray Service

The spray service, so popular among fruit growers, is carried on in coöperation with the Extension Service of the Connecticut Agricultural College. The Station botanists and entomologists maintain constant touch with the development of fungous and insect pests and by use of special weather data furnished by the New Haven office of the Weather Bureau, are able to advise orchardists as to the time of the several spray applications. The warnings or "bulletins" are telephoned to the several County Agents, who in turn send them out over a previously arranged telephone chain.

PROGRESS OF INVESTIGATIONS

Here follow brief notes on those projects of special interest or on which definite results have been obtained during the year. No attempt is made to discuss all of the investigations under way, a list of which will be found on page 766.

Biochemistry

Cell Chemistry. The investigation of the tobacco leaf has been continued throughout the year. Existing methods for the determination of nitrate, ammonia and amide nitrogen have been so modified as to become applicable to tobacco which, owing to the presence of the volatile alkaloidal base nicotine, presents unusually difficult analytical problems. Pure specimens of nicotine have been prepared by a method especially developed for the purpose and the dissociation constants of this base have been determined. Curves drawn with the knowledge of these constants form the basis of a new method for the determination of "free nicotine" in tobacco, a matter of some importance in the judgment of tobacco quality. Three papers embodying the results of this work have been published.

Protein Chemistry. Two papers on the basic amino acids of crystallized horse hemoglobin and of the keratins of human hair respectively have been published in the *Journal of Biological Chemistry.* These investigations were undertaken as illustrations of the application of the recent modifications of the methods of base analysis to proteins with unusual distributions of amino acids. An investigation of methods for the preparation of the sulfur-containing amino acid cystine has been carried out as well as an investigation of the compounds that this substance forms with silver and copper. A method for the separation of cystine from histidine has been developed and employed in the analysis of the keratins of human hair.

Nutrition. An elaborate experimental investigation of the effect of certain inorganic constituents of the diet on the growth of bone tissue has been planned and in part completed. Various phases of this investigation are being conducted with the collaboration of scientists of other institutions, notably Yale University, the Johns Hopkins Medical School, and Vanderbilt University. This investigation is founded on a method of varying the proportions of the determining factors in the diet that was developed in this laboratory recently.

An investigation of the vitamin distribution in watercress has been completed. This widely used salad "green" has been shown to provide a rich source of vitamins A and E as well as a moderately rich source of B.

A study of the curious phenomenon known as "refection" in the rat has been completed. The existence of refection in a rat colony renders the investigation of vitamin B-bearing tissues difficult, if not impossible. The failure of our attempts to produce this phenomenon in our animals was therefore gratifying.

The biochemical laboratory has also coöperated with Dr. F. G. Benedict of the Nutrition Laboratory of the Carnegie Institution

of Washington at Boston in a study of the fundamental characteristics of the basal metabolism of the rat. The effect upon the basal metabolism of the rate at which the animal has been grown has also been investigated. It is now possible to grow animals at any prescribed rate within the growth capacity of the species and the detailed study of animals that have been grown at widely different rates is expected to lead to valuable conclusions regarding the optimal rate of growth.

The annual grants of the Carnegie Institution of Washington first made in 1904 to the late Dr. Thomas B. Osborne, and since 1912 jointly to Dr. Osborne and Prof. Lafayette B. Mendel, have broadened the scope of the Station's work in the field of biochemical investigation. This generous financial assistance has been continued through the current year by a grant to Professor Mendel and Dr. Vickery.

Botany

The Willow Scab Fungus. Work on this disease has continued. It was found in North America for the first time in 1927 by the Station Botanist, although it had been known for some years in Europe. Bulletin 302, March, 1929, presents the results of the investigation up to that time. During the past year further data have been obtained on the occurrence of this disease in the United States and Canada, on control by spraying and on the life history of the fungus itself.

Chestnut Blight. Some hope exists that the virulence of this fungus may decrease as time passes, and that we may in the future hope to reestablish this very valuable forest tree. Several lots of chestnut seedlings have been planted in various parts of the state to determine the amount of natural infection; also regular observations are being made at two locations on native trees under forest conditions to determine the spread of the fungus.

Damping-off of Vegetable Seedlings. This constitutes a source of considerable loss each year to the vegetable industry on both greenhouse and field crops. Various soil treatments are being compared in an effort to find one that is both effective and practical. Excellent results have been obtained by the use of acetic acid and formalin.

Entomology

Asiatic Beetle. The results of the investigations on the life history, habits and methods of control of the Asiatic beetle have been published as Bulletin 304. Work on the control of this insect by applying lead arsenate in varying amounts to the soil has been continued, as well as tests for the effect of such applications

on the germination and growth of the different kinds of grasses used in making lawns. New plots on several lawns in Westville were laid out to check work previously done with lead arsenate and to assure a correct method of application per unit area. Observations will continue for a few years.

Oriental Peach Moth. An investigation on the life history, habits and control of the Oriental peach moth has been under way for several years and the data have been assembled in Bulletin 313. No satisfactory control by means of applications has yet been discovered. Consequently, control or partial control by parasites has been given considerable attention. In the late summer a request was received from the Connecticut Pomological Society that the Station undertake to rear these parasites and distribute them in peach orchards in 1930. A study of possible methods was made and a constant temperature room and a work room were fitted up with the necessary cages and apparatus, and an electric refrigerator was installed. A portion of the greenhouse was assigned to this work and strawberry plants were grown in order to rear the strawberry leaf-roller, which is a host to one of the parasites, the *Macrocentrus ancylivora.*

Mexican Bean Beetle. During the summer, the Mexican bean beetle was found to be present in certain towns in Fairfield, Litchfield, Hartford and New Haven Counties, in the western half of the State. The first discovery was made by Dr. E. P. Felt, of Stamford. It is questionable whether this insect will become a serious pest in Connecticut, as it is thought to be near its northern limit. However, it has seemed best to conduct a brief study of the life history of this insect and methods of controlling it in Connecticut and therefore a new project is added to the list.

Cabbage Root Maggot. Investigations were carried on in the control of the cabbage root maggot, principally to determine whether or not the gains in yield were justifying the expense of the control methods. This project will be continued for another season.

Squash Vine Borer. Insecticides were used directly on the larvae of the squash vine borer to see whether the control of this pest could be made more effective.

Forestry

The Rainbow Forest. Originally planted to both conifers and hardwoods, this experimental forest is now essentially coniferous, the hardwoods having succumbed to disease, insects and unfavorable conditions. The soil is very sandy, too much so for cultivated crops or pasture and was selected as representing one type of our sub-marginal land. The plantings are in blocks of one or two

species and constitute not only a trial of the various species of conifers, but of various spacings. As they have grown, experiments in thinning, pruning and other silvicultural practices have been possible. A complete discussion of the results up to 1924 is available in Bulletin 262.

Work during the year has included very little planting but considerable thinning. Several new sample plots have been laid out and the thinnings have been extended to other plantations which were in need of such treatment.

In coöperation with the Soils Department a study of pine leaf litter and its effect on sandy soil was begun. Several plots were laid out, from which the leaf litter was removed or treated in such a way as to alter its character, by burning or otherwise, so that a comparison might be made later with the check area where the litter was left in its natural condition. There is reason to believe that pine needles unmixed with hardwood leaves have a deleterious effect on soil conditions rather than otherwise. It is hoped that some definite data on this point will be secured through this experiment.

Treatment to Prolong the Life of Native Woods for Tobacco Shade Poles. The coöperative demonstration at the Tobacco Substation is being continued although no new posts have been set. It is planned to try out some other species in addition to those already under test.

The Distribution and Rate of Growth of the Forest as Influenced by Soil Conditions. The studies on the rate of growth of red pine in pure plantations have been continued and the result prepared for publication. Normal growth curves have been prepared, thus providing a "yardstick" by which growth on different sites can be computed to a common age and the quality of sites compared.

Plant Breeding

Hereditary Characters in Corn. The inheritance and linkage relations of a sterile tassel condition have been studied further and its possibilities for use in the production of crossed seed corn determined. This character is being introduced into the seed-parental stock of Canada-Leaming to be used in growing hybridized seed without detasseling. Other characters including sugary with abnormally high and low segregation, are being studied further.

Effects of Inbreeding and Crossing Upon Corn. The investigation bearing upon conflicting theories as to the interpretation of hybrid vigor is being continued but has not reached a stage where progress is to be reported.

Improvement of Naturally Cross-Fertilized Plants. Canada-Leaming, a cross of inbred strains of Canada Yellow Flint and

Leaming, has been tested the second year in Massachusetts, Vermont, New Hampshire and Maine and in spite of the unfavorably dry season has been outstanding in many places in its early maturity, large stalk growth and heavy production of grain. This companion of Burr-Leaming combines many of the qualities of earliness and hardiness of the flint type with the large stalk growth and grain yield of the dent type.

About 400 first generation crosses of inbred strains of Whipple's Early Yellow sweet corn were grown in a preliminary trial for a market garden type of sweet corn having the uniform size and shape of ear and even maturity characteristic of crossed corn. Some 30 of these have been selected for further trial.

A new hybrid type of canning Evergreen sweet corn has been tested three years. This has been named Green Cross and will be distributed to canners and seed growers in 1930.

A new variety of Early Yellow sweet corn called Spanish Gold has been developed by crossing an amber-colored flint corn from Spain with Alpha white sweet and Gaspe flint and other varieties of extreme earliness. The new variety in the trials at Mount Carmel has ripened earlier and produced somewhat larger ears than any other extra early variety grown in comparison with it. Seed will be distributed for general trial in 1930.

New varieties of straightnecked squash, early pepper, and spinach are ready for distribution for trial by market gardeners under various soil conditions and different methods of handling.

Preliminary results of inbreeding and crossing strawberries show that this plant behaves much the same as corn. With the added advantage of vegetative propagation it is to be hoped that valuable varieties can be originated in this way. Inbred strains of Harvard 17, Chesapeake and Glen Mary are being grown in the greenhouse for the purpose of making many crosses in a further test of this method.

Black raspberries show no reduction in growth or fruitfulness after two generations of self-fertilization. Strains differ in size, form and number of fruit as well as in cane and foliage color and other details of vegetation. Some strains are uniform and come true to type from seed. A comparison of seed propagation with tip-layering will be made to see if there is any advantage in the former method. Black raspberry plants are easily grown from seed and since these seedlings start free from mosaic there is a definite advantage in this method of propagation.

Improvement of Naturally Self-Fertilized Plants. The root-rot resistant strains of shade tobacco have continued to show a noticeable superiority in this respect over the variety generally grown. The origin and inheritance of this character are being studied. A combination of some of the growth characters of Round Tip tobacco with the quality and leaf characters of Cuban Shade is

being attempted. Several selections in this material are being tested for uniformity, growth habit and leaf quality.

A new variety of tomato combining the earliness of Alacrity with the shape and color of Bonny Best is being tested on various soils under market garden conditions.

Soils

Nutrient Requirements of Connecticut Soil Types. During the past four years 70 different soils representing practically all the important soil types of the State, under various conditions of former treatment, have been carefully studied as to plant food constituents and acidity as shown by chemical analysis, and as to the response of crops to various combinations of nitrogen, phosphorus and potassium, both with and without lime, under greenhouse conditions. The crops used include tobacco, alfalfa, lettuce, beets, carrots, cabbage, turnips, oats, buckwheat and sweet corn. These respond to lime in the following order from highest to lowest lime requirement of the crop: Lettuce, alfalfa, beets, carrots, cabbage, turnips, sweet corn, oats, tobacco and buckwheat.

Of the 70 soils, 67 need lime for lettuce, 64 for alfalfa, 60 for beets, 58 for carrots, 50 for cabbage, 43 for turnips, 40 for sweet corn, 34 for oats, 9 for tobacco and 4 for buckwheat.

Nitrogen response under greenhouse conditions is so abnormally low, due to the favorable conditions for liberation of nitrogen from the soil, that no definite conclusions can be drawn. Of all the crops grown, oats appear to show the most marked response to nitrogen. Tobacco is the only other crop that has shown definite symptoms of nitrogen deficiency on any appreciable number of soils.

Phosphorus is a serious limiting factor for nearly all crops grown in the case of 63 of the 70 soils. Three old tobacco soils included in the list failed to show response to phosphorus. Alfalfa, tobacco and turnips were almost complete failures on soils that are particularly low in this element. Data is somewhat irregular for other crops, but the approximate order of response to phosphorus was alfalfa, tobacco, turnips, sweet corn, cabbage, lettuce, carrots, oats, buckwheat.

Potassium is of such low availability that only six of the 70 soils fail to show measurable response. However, the majority of the soils produce somewhat higher yields without potash than without phosphorus. Differences in the potash requirement of the various crops are not sufficiently great to justify any statement as to order of response for the crops grown. Alfalfa and tobacco are the only ones that suffer markedly when the soil fails to supply sufficient potash.

Two other malnutritional abnormalities of tobacco have appeared

on some of these soils. On three very acid soils tobacco has shown symptoms of an excess assimilation of manganese (manganese toxicity). On several heavily limed soils where the fertilization has been deficient in nitrogen or potassium or both, a physiological trouble known as "frenching" has appeared. Factors affecting the occurrence of these troubles are being studied more fully.

Two year old maple transplants failed to show any consistent differences in growth on nine soils on which tobacco had previously shown marked response to the various nutrients. The experiment with young maple transplants will be continued for several years under outdoor conditions on a soil of marked nutrient deficiency.

In general, it may be stated that the soil type is less important than the past history of the field in determining the present nutrient requirements of the soil for the various crops. However, under field conditions, differences in the physical character of the soil, topography and stoniness will be of paramount importance in determining economic response to fertilizer and lime treatment.

Farm Soil Surveys. During 1928 and 1929 nearly two hundred farms in the towns of Woodstock, Griswold, Coventry, Brooklyn, Columbia, Stonington, North Stonington and Canterbury have been carefully surveyed as to soil types on the various fields of the farm. This is part of a project, the "Economic Significance of Soil Type," conducted in coöperation with the Agricultural Economics Department of the Storrs Agricultural Experiment Station. Soil acidity tests of practically every field on the above farms, a total of nearly 1500 tests, gives the following results:

0.5% of fields—neutral or above (7.0 + pH)
12.9% of fields—slightly acid (6.2-7.0 pH)
28.1% of fields—moderately acid (5.4-6.2 pH)
56.0% of fields—strongly acid (4.6-5.4 pH)
2.5% of fields—very strongly acid (3.8-4.6 pH)

Available phosphorus tests of all soils collected from three of the above towns show the following indications:

1.3% of fields—very high test (40 lbs. + per A)
4.7% of fields—high test (20 lbs.-40 lbs. per A)
6.6% of fields—medium test (10 lbs.-20 lbs. per A)
31.1% of fields—low test (5 lbs.-10 lbs. per A)
56.3% of fields—very low test (less than 5 lbs. per A)

A serious deficiency of available phosphorus undoubtedly exists on dairy farms in the highland regions of the State.

Leaching Experiments. During the spring of 1929 a battery of lysimeters was constructed at the Tobacco Substation in Windsor. This includes a long concrete-walled chamber built underground except for windows and roof, with raised earth platforms on each

side and at one end, in which the drainage cylinders are imbedded. The bottoms of these cylinders drain into brass, tin-lined tubes which lead through the walls and drain into collecting tanks on shelves along the walls of the chamber. The drainage cylinders, or lysimeters, are 20 inches in diameter. Thirty-four are 10 inches in depth while 34 are 20 inches in depth, the former filled with a seven-inch depth of surface soil, while the latter have also a ten-inch layer of subsoil. The capacity of the equipment provides for 34 additional lysimeters 30 inches in depth which have not yet been installed. This equipment, built at a cost of $3,000, compares favorably with any other of its kind elsewhere and is the only apparatus in operation in New England that provides for collection and analysis of the soil and fertilizer constituents that are lost through leaching.

The first problem to be undertaken is a study of the losses occurring under heavy applications of various types of nitrogenous fertilizers. Sixteen different sources of nitrogen and four different types of soils are under investigation. The current season was exceptionally dry and practically no drainage water was collected until the entire crop was destroyed by hail on July 31. Much valuable data has since been collected which will be published later.

Forest Soil Studies. In coöperation with the Forestry Department of this Station, an intensive study of the soil factors affecting the site quality for red pine in plantations is being continued. Typical soils under various conditions of forest cover are being investigated in the laboratory as to biological, chemical and physical characteristics of the various soil horizons. Results to date indicate that the micro-organisms of the soil are most active in the fresh litter. In this layer organic nitrogen is being rapidly transformed into ammonia. Only a small part of this is transformed into nitrates in a three months' incubation period, except on soils of slight acidity. Ammonification occurs to a lesser degree in the older humus layer, which lies beneath the litter in forest soils where "mull" formation is not active. Nitrate formation rarely occurs in this type of material. The more favorable "mull" types, under hardwood cover, usually show nitrate production in the surface layer of mineral soil.

Three main groups of forest soils are represented in Connecticut. The first of these, the "podsol type," has a definite layer of light gray mineral soil occurring just beneath a thick humus covering. Below this gray layer are layers of dark coffee brown or rust brown color. This type is most general under hemlock-white pine-hardwoods associations in the northern part of the State, although it occurs locally in oak and beech forests in southern Connecticut. The second, or "mull type," has no older humus layer under the leaf litter, and the upper mineral soil is dark brown in color and of

a mellow, crumb-like structure. Earthworms are active. This type is characteristic of the best hardwood forests, where ash, elm, basswood, black and yellow birch and hard maple predominate.

A third or intermediate type has no definite gray layer beneath the forest humus, but there is an accumulation of leaf mold, and the upper mineral soil is firm and compact, with no earthworm activity to mix and mellow the soil. This is the most common type on the second growth and sprout hardwoods forests with a predominance of red and scarlet oak.

An important object in further research is to determine the factors that produce these forest soil types and to predict the effect of various silvicultural practices in modifying them.

Tobacco Substation

Despite the fact that the entire crop of tobacco on the station farm was ruined by hail August 1, satisfactory progress has been made on most of the active projects.

Shade Tobacco Resistant to Black Rootrot. The 4R strain that was found two years ago has proved this year to be very highly resistant to rootrot. This is particularly gratifying since the ordinary strain of Cuban shade tobacco is very susceptible to this disease and the losses have been very large. This should make it possible to grow shade on many fields that have been abandoned because of black rootrot.

Depressing Effect of Stable Manure. Tobacco was stunted and unusually poor on plots that received annual applications of stable or "adco" manure for four successive years. On these plots, the manure was used *in addition* to the regular commercial fertilizer application. The unusually dry season probably accounts for this behavior of the crop, which is quite different from the results of the wet seasons of 1927 and 1928.

Cause of Poor Combustion of a Dry Year Crop. Chemical comparison of tobacco of a dry season (1924) and a wet season (1927) shows the poor burning tobacco of the dry season contained more calcium, magnesium, phosphorus, sulfur, chlorine and nitrogen, all of which may be injurious to burn as measured on the leaf, while the good burning crop was distinguished by the increased potash, which aids combustion. Also the alkalinity of the water soluble ash of the wet year crop was higher. This is considered a good index of combustability.

Seasonal Fluctuation in Soil Reaction. In trying to find the optimum soil reaction for tobacco production it will be necessary to take into consideration the period of the year when the test is made. On plots where monthly tests have been made for the past two years the reaction was found to be highest in December and lowest in June, the extreme variation being from .5 to 1.0 pH unit.

FIELD DAY

The Station field day at the Mount Carmel Farm, August 29, was one of the most successful we have ever had. Five hundred visitors gathered at the farm to inspect the experimental plots and to take part in the program. President George A. Works of the Agricultural College and Dr. E. W. Sinnott of Columbia University gave the principal addresses.

The Tobacco Substation Field Day was also well attended. Fifty of the visitors were members of a party of tobacco growers from Canada, who made this one of the important features of their tour.

The abandonment of the State Fair at Hartford relieved the staff of the very considerable task of preparing an exhibit. Several smaller exhibits were sent to town fairs.

LIBRARY

About 900 accessions of permanent value were added during the year to the Station library. Journals purchased now number 85, in addition to which some 30 farm journals and about 24 foreign agricultural journals are received regularly in exchange. The total number of bound volumes is now about 17,000.

PHYSICAL EQUIPMENT

The most extensive addition to the Station's equipment is the lysimeter installation at Windsor, mentioned elsewhere. Also the rat room of the biochemical laboratory has been completely renovated, new steel shelves and tables being installed. Other items are: a Pfaudler vacuum still, two electric refrigerators, a hydrogen sulfide apparatus, a Hobart chopping device for preparing forest litter samples, and a Parr combustion equipment for determining soil organic matter.

CHANGES IN STAFF

Appointments:

Henry Bull, M.F., Assistant Forester, August 1, 1929.
Miss Dorothy Amrine, B.Litt., Editor, July 1, 1929.
O. E. Street, M.S., Plant Physiologist, Tobacco Substation, July 1, 1929.
Mrs. Catherine R. Miller, M.A., Secretary Plant Breeding and Soils Departments, September 1, 1929.

Resignations:

Mrs. Mary B. Hunter, Secretary Plant Breeding and Soils Departments, August 31, 1929.

ACTIVE PROJECTS, 1929-1930

Analytical Chemistry

Dr. E. M. Bailey in charge

1. Inspection of Fertilizers.
2. Inspection of Feeding Stuffs.
3. Inspection of Foods and Drugs.
4. Calibration of Babcock Glassware and Thermometers.
5. Inspection of Insecticides and Fungicides.
7. Analysis of Special and Miscellaneous Foods.

Biochemistry

Dr. H. B. Vickery in charge
In Collaboration with Dr. L. B. Mendel, Yale University

1. Cell Chemistry.
   a. A detailed examination of the nitrogenous constituents of plant cells, in particular those of leaf tissues, and the further development of methods for the determination of the different forms of nitrogen in extracts of such tissues.
   b. An investigation of the nitrogenous constituents of the tobacco plant.
2. Protein Chemistry.
   a. The methods for the determination of the basic amino acids of proteins with the object of effecting improvements.
   b. Methods for the preparation of pure proteins on a large scale with the object of obtaining material for chemical and nutritional study.

Entomology

Dr. W. E. Britton in charge

3. Spraying and Dusting Experiments on Apples and Peaches. (With Botany.)
6. Control of Foul Brood of Bees. (Inactive.)
9. Insect Survey of Connecticut.
16. Experiments with the Cabbage Maggot.
17. Life History and Methods of Controlling the Oriental Peach Moth, *Laspeyresia molesta.*
18. Life History of Imported Currant Worm.
20. Life History, Habits and Control of the Imported Birch Leaf-Miner, *Fenusa pumila.*
21. Life History and Control of the Spinach Leaf-Miner.
26. Experiments on the Control of Squash Vine Borer.
27. (New) Rearing and Distributing Parasites of the Oriental Peach Moth.
28. (New) Investigations on Oil Sprays.
29. (New) Life History of the Mexican Bean Beetle.

Control Projects

10. Inspection of Orchards and Nurseries.
11. Control of Gipsy Moth. (With U. S. Dept. Agric.)
12. Elimination of the Mosquito Nuisance in Salt Marshes.
13. Inspection of Apiaries.
19. Control of the European Corn Borer. (With U. S. Dept. Agric.)
24. Control of the Asiatic Beetle. (With U. S. Dept. Agric.)
25. Control of the Japanese Beetle. (With U. S. Dept. Agric.)

Forestry

Mr. W. O. Filley in charge

1. Experimental Plantations on a Sandy Tract at Rainbow.
   a. Comparison of a wide variety of conifers and hardwoods.
   b. Methods of management for those species that have survived.
   c. Studies on growth and habits of the several species.
2. Effect of Thinning in White Pine. (At Shaker Station.)—Three

Botany

Dr. G. P. Clinton in charge.

2. The Nature and Cause of Mosaic Disease of Plants.
5. Plant Disease Survey of Connecticut.
6. *Thielavia basicola,* a Study of the Perfect Stage.
8. Spraying and Dusting Experiments on Apples and Peaches. (With Department of Entomology.)
15. Chestnut Blight, Virulence Studies.
16. Tobacco Diseases, Especially Black and Brown Root Rot. (At Tobacco Substation.)
20. Tree Diseases.
23. Rogueing as a Control for Raspberry Mosaic. (With U. S. Dept. Agric.)
24. Willow Scab, Studies of Morphology of Fungus (perfect stage, inoculations and control).
26. Tests of Various Materials for Soil Treatment in Control of Dampening-off of Vegetable Seedlings.
27. A Study of an Elm Disease in Connecticut.
28. Studies on the Identification of Apple Varieties by Seed Characters.

Control and Service

12. Seed Testing.
25. Apple Scab, Determination of Discharge of Ascospores in Connection with Telephone Spray Service.

4. Method for the Improvement of [illegible] particular attention to Tobacco and Vegetable Crops, such as lettuce, lima beans and tomatoes.

Soils

Mr. M. F. Morgan in charge

1. The general project "What Soil Characters are Factors in Determining the Agronomic Value of Utilization of Land" has developed into five distinct phases as follows:
   a. A descriptive inventory of Connecticut soil types, in relation to their adaptation for crops, pasture and forest.
   b. The physical and chemical characteristics of important soil types, including the nutritive response of tobacco and other plants when these soils are variously treated in the greenhouse.

c. Fertilizer experiments with vegetable crops on several typical soils in concrete frames.
d. A study of the physical, chemical and biological conditions of the soil in natural mixed and planted coniferous forests. (With Forestry Department.)
e. A study of the drainage losses and other changes that occur in several soils under heavy fertilization, as practiced for tobacco and vegetables. (Lysimeter experiments at Windsor.)

2. Experiments in Lawn Fertilization, Seeding and Management.

Tobacco Substation

Dr. P. J. Anderson in charge

1. Fertilizer Experiments: Various Sources and Rates of Nitrogen, Phosphoric Acid and Potash.
2. Field Tests with Farm Manure.
3. Field Tests with Manure Substitutes.
4. Tobacco Nutrition Studies: the Rôle of Nitrogen, Sulfur, Chlorine, Potassium, Calcium, Manganese, Boron and Magnesium.
5. Improvement of Havana Seed Tobacco.
6. Improvement of Broadleaf Tobacco.
7. Improvement of Cuban Shade Tobacco.
8. The Effect of Various Winter Cover Crops used on Tobacco Land.
9. Brown Root Rot of Tobacco. (With U. S. Dept. Agric.)
10. Studies on Black Root Rot of Tobacco.
11. Soil Reaction in Relation to Tobacco.
13. Preservative Treatment of Shade Tent Poles.
17. The Rôle of Humidity and Temperature in Curing Tobacco.

PUBLICATIONS

Bulletins

No. 296. Report on Commercial Fertilizers for 1928.
No. 297. The Effect of Topping and Suckering on Havana Seed Tobacco.
No. 298. Report of the Director for the Year Ending October 31, 1928.
No. 299. Report of the Tobacco Substation at Windsor for 1928.
No. 300. The Composition of some Commercial Insecticides, Fungicides, Bactericides, Rodenticides and Weed Killers.
No. 301. Control Studies on the Plum Curculio in Connecticut Apple Orchards.
No. 302. The Willow Scab Fungus.
No. 303. Report on Commercial Feeding Stuffs for 1928.
No. 304. The Asiatic Beetle in Connecticut.
No. 305. Report of State Entomologist for 1928.
No. 306. Soil Reaction and Liming as Factors in Tobacco Production in Connecticut.
No. 307. Report on Food Products and Drugs for 1928.

Bulletins of Immediate Information

No. 62. The Control of the Asiatic Beetle in Lawns.
No. 63. The European Corn Borer, a Menace to Corn, Vegetable and Garden Plants.
No. 64. The Japanese Beetle Quarantine.
No. 65. The Asiatic Beetle Quarantine.
No. 66. The Satin Moth Quarantine.
No. 67. Control of Ant Invasions. (Revised edition of Bulletin of Immediate Information No. 17, July, 1922.)

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VICKERY, HUBERT BRADFORD, and LEAVENWORTH, CHARLES S. The basic amico acids of horse hemoglobin. Jour. Biol. Chem., **79**: 377-388. 1928.

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WHAT THE STATION CAN DO

Each mail brings to the Station requests for information and service, the range of subjects being almost without limit. Every effort is made to comply with these requests, even though they are outside the fields under investigation. This is one of the purposes for which the library is maintained. However, some of the letters request help that requires an intimate knowledge of live stock management and the like and others ask us to make laboratory determinations for which we do not have the equipment or staff. Therefore it is helpful to publish from time to time a list of the subjects on which we can furnish information and the kinds of samples we can accept.

The Station can furnish information on:

Fertilizers and fertilization.
Soils and management.
The chemical composition of foods, drugs, insecticides and fungicides.
The composition of diabetic foods.
Insect pests of plants and their control.
Fungous and other diseases of plants and their control.
Sprays and spraying.
Fruits and fruit management.
Weeds and their control.
Forestry—all phases.
Care of shade trees.
Plant breeding—especially field and sweet corn.
Lawns, establishment and care.
Bees.
Mosquito elimination.
Tobacco culture.

Samples and specimens that can be analyzed, tested or identified:

Fertilizers.
Feeding stuffs.
Foods and drugs.
Milk—except for bacterial count.
Seeds.
Weeds and other plants.
Insects.
Diseased and injured plants.
Soils.

The Station cannot furnish information on:

Live stock feeding and management including poultry.
Animal diseases.
Household management.
Clothing.
Farm management.
Marketing and coöperation.

Requests for information on these subjects should be sent to the Connecticut Agricultural College at Storrs.

The Station cannot make analyses and examinations of:

Drinking water—apply to the State Board of Health, Hartford.

Milk for bacterial content—apply to the Dairy and Food Commissioner, Hartford.

Sick or dead poultry should be sent to the Poultry Department, Storrs Agricultural Experiment Station, Storrs, Conn.

All of which is respectfully submitted.

WILLIAM L. SLATE,
Director.

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